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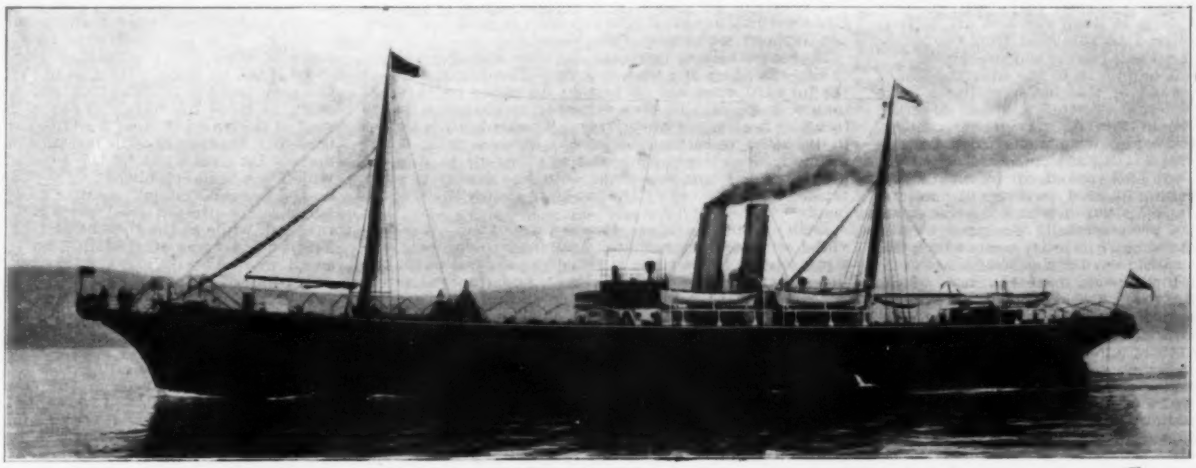
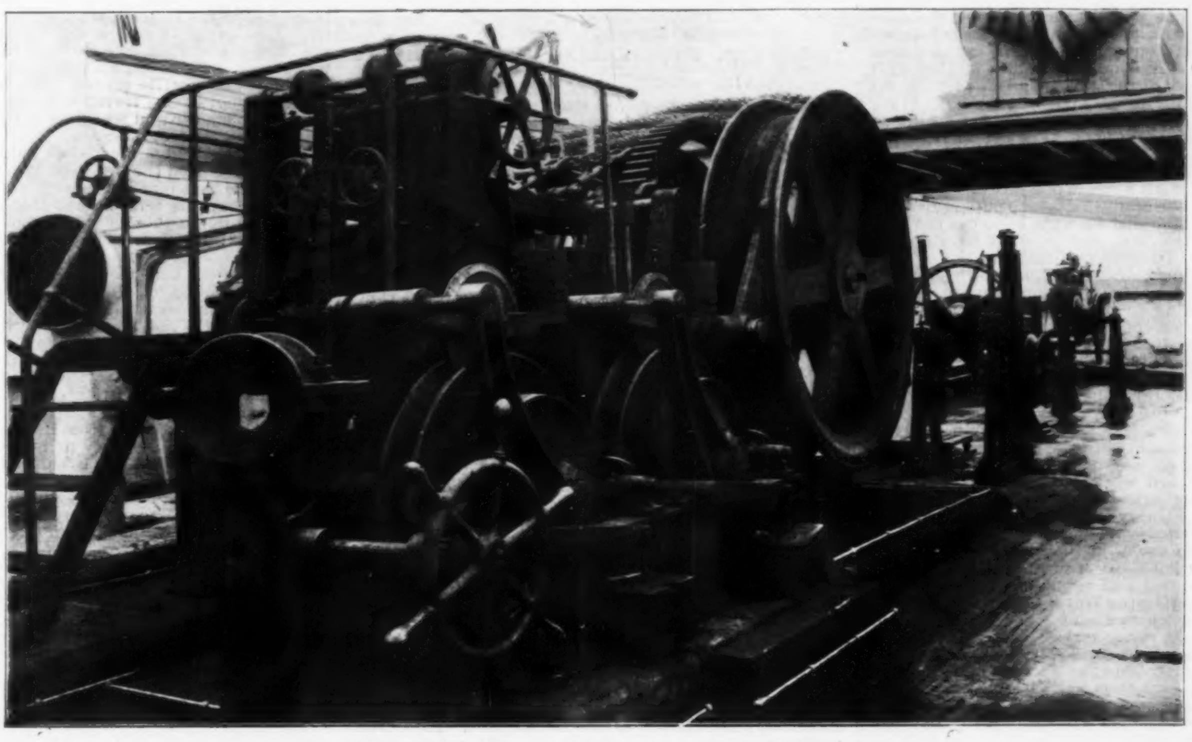
GERMANY'S FIRST CABLE-LAYING STEAMER.

DAVID J. DUNLOP, of the Inch Shipbuilding Works, of Port Glasgow, has constructed Germany's first cable-laying steamer, the "Von Podbielski." It is only within the past year or two that Germany has entered into competition with the other countries in the work of laying submarine cables, and the scheme has been so favored that already a direct cable from Germany to the United States is in contemplation. Prior to 1898 there was only one firm in Germany engaged in this class of work, Franz Clouth, of Cologne. His business, however, which was, comparatively speaking, only a small one, developed to such an extent that it was converted into a company, the Land und Seekabelwerke. Extensive factories for the manufacture of the cables were projected and commenced at the small town of Nordenham, on the river Weser, only a few miles distant from Bremerhaven. Shortly after the flotation of



THE FIRST GERMAN CABLE-LAYING STEAMER "VON PODBIELSKI."

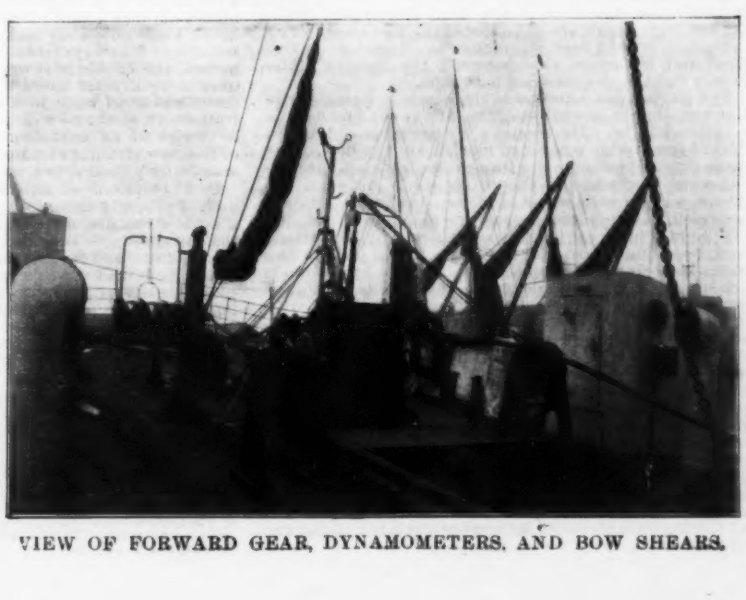


PAYING-OUT MACHINE ON THE "VON PODBIELSKI."

this concern, another company was floated to carry on similar work, Messrs. Felten & Guilleaume, of Karlswerke Mulheim-am-Rheim. There were thus two cable-laying firms in Germany, and as it was considered that the competition which was bound to ensue between the two companies would probably prove detrimental to the interests of what was, after all, only a rising industry, negotiations were opened up for the amalgamation of the two companies. These negotiations were successful, and the two firms combined into one company, called the Norddeuesche Seekabelwerke Actiengesellschaft. In addition to these two concerns, there is a third firm, the Deutsche Atlantische Telegraphengeilschaft, interested in this enterprise. The factories are situated at Nordenham, as originally contemplated by the Land und Seekabelwerke, and in a few weeks' time the building will be completed.

The "Von Podbielski" is one of the finest vessels that has yet been constructed for cable-

CABLE BEING PAID INTO FORWARD TANK.



VIEW OF FORWARD GEAR, DYNAMOMETERS, AND BOW SHEARS.

laying purposes. She is a twin screw steamer 255 feet in length between the perpendiculars; breadth 35 feet, having a deadweight carrying capacity of 1,400 tons on a draught of 16½ feet; and with a cargo of 500 tons she can attain a speed of 13 knots. The machinery consists of two sets of triple expansion engines, having cylinders 17, 28½ and 47 inches, with a stroke of 33 inches, and a working pressure of 180 pounds, each engine being fitted with Edward's air pump and separate centrifugal pump for circulating water through condensers, feed pumps, feed heaters, and all the latest improvements are furnished to meet the requirements of a vessel of this special class.

Special attention has been devoted to her construction so that she may satisfactorily fulfil all the requirements of the work for which she is to be employed. She has a cut water stem and an elliptical stern. The paying out and picking up gear has been so fitted that the friction of the cable upon the hull of the vessel is reduced to a minimum. The two masts are of steel and provided with steam winches and other appliances for working the derricks.

The decks have received special attention in their design. The upper deck is flush fore and aft, so that no obstruction is offered to the lead from the cable tanks to the picking up and paying out machines.

Teakwood has been employed in the construction of the spar deck. Forward of the boiler casing a large house is provided wherein is fitted a steam steering gear, and a large room for the navigating officers. Overhead is the flying bridge with the chart and wheel house.

The cable is paid out and picked up by means of a double combined picking up and paying out machine at the bow, and a paying out machine at the stern. These machines have been specially designed by the contractors and contain many improvements which will be submitted to practical tests for the first time.

The double combined machine at the bow of the steamer is erected on three steel frames. By this arrangement the two machines are placed side by side. The apparatus is driven with two pairs of engines, which are so placed that one engine is sufficient to actuate either the paying out or the picking up machines, or the latter two may be driven at one and the same time by both pairs of engines. By employing the two pairs of engines simultaneously, however, it is possible to pay out the cable with one machine, while picking it up with the other. Then again cessation of work does not necessarily ensue if one pair of engines breaks down, since the second pair of engines can be at once requisitioned to carry on the work. Under ordinary circumstances one pair of engines would be adequate to drive either machine, but in the case of heavy loads the reserve pair of engines can be utilized as a supplementary help. Each cable machine is fitted with two speed gears and lifting powers; the picking up machine for 25 tons lift at one knot, or 10 tons lift at 2½ knots; and the paying out machine for 10 tons lift at 2½ knots, or 6¼ tons at 4 knots. The cylinders of the driving engines are of 8 inches diameter, with an 8-inch stroke, and develop 110 brake horse power at 300 revolutions per minute, with a steam pressure of 150 pounds per square inch. The crankshafts of the engines are placed in a position parallel with the center of the ship and are geared to the first motion shaft by a double helical bevel gear. To take one machine out of gear altogether, the engineer draws the bevel wheel along its shaft by the aid of a large screw nut concentric with the shaft, and working on a screwed shoulder, the nut being worked by means of a tommy bar.

The main drums, over which the cable passes, are geared internally, and the outsides of the gear rings act as the brake drum. To pay out the cable without the aid of the engines this combination drum, with the exception of the holding back sheave, is the only part of this machine which is running. A shaft is fixed upon the steel frames and both the drums of the paying out and picking up machines run loosely upon it. The brake screws are worked by a worm gear by means of which fine adjustment, together with great power, is attained. One very great improvement (the invention of the contractors) has been incorporated in these brakes. These are adjusting nuts, which enable the brake to be regulated to any tension, so that the brakes may be applied and released with great frequency without altering the set tension in the least.

The brake blocks, which are of elm, are attached to steel brake straps. A water service pipe is fitted on the periphery of each brake band, with nozzles at frequent intervals to distribute the water round the face of the brake drum and thus keep it cool while working. A small pump is supplied for this purpose. The brake bands are suspended on springs, so that the bands when released leave the brake drums equally all round.

The machine is constructed of wrought steel throughout, with the exception of the gear wheels and bearing castings, which are constructed of cast steel. The cable drums are 5 feet 8½ inches in diameter on the tread and 19 inches wide between the flanges. The total weight of the machine is 31 tons.

The paying out machine at the stern is a single machine with only one cable drum, driven by one double cylinder engine. Its erection is somewhat similar to that of the double combined machine in the bow. The cable drum overhangs the frames upon which the machine is erected. On the drum shaft between the frames a large gear wheel and two brake pulleys are provided. In this instance, as this machine is intended for paying out long lengths of cables, and will, therefore, be submitted to long runs, the brake pulleys run in tanks of water to keep them cool. The brake bands are similar to those employed in the double combined machine in the bow, except that they are fitted in with ordinary weighted levers. The disadvantage of this style of braking, however, is that the leverage can only be modified and the brake power correspondingly altered by the removal or addition of weights. But, in this case, the contractors have made a decided improvement. They adjust the leverage and braking power by moving the weights along the lever by means of a handwheel and screw, so that a variety of tensions on the cable drum may be obtained by a simple operation. If necessary, the brakes can be released bodily by a hand wheel and worm gear, and they can also be made to act individually or in concert. Any jumping of the levers is obviated by connecting a rod at the end of each brake lever with a dashpot.

The cable drum on this machine is not so large as that employed upon the former machine, being only 5 feet 8½ inches in diameter and 13 inches wide between the flanges. The weight of the machine is 15½ tons—just half of that of the double combined machine. The driving engine is consequently not so powerful, since, though the cylinder and stroke are exactly the same in every respect, it only develops 60 brake horse power at 250 revolutions per minute with a steam pressure of 90 pounds per square inch. This machine is placed on the spar deck, and the engineer who is responsible for its control is provided with a working platform, from which he can watch the cable as it leaves the vessel, while all the levers are placed within convenient reach of him.

At the bow of the vessel are fitted three sheaves, which are carried in bearings on girders built into the vessel. Guards are provided with each sheave to prevent the cable jumping therefrom. In order not to destroy the contour of the bow of the vessel the plating of the stem is worked up to meet the guards of the sheaves. At the stern only one sheave is fitted, and the bearings for carrying the same are attached to girders which are built into the ship in a similar manner to those in the bow of the vessel.

Three tanks are provided for the storage of the cables—two forward and one aft. The dimensions of the forward ones are 26 feet in diameter by 10 feet 9 inches deep, and 31 feet 6 inches in diameter by 10 feet 3 inches deep, respectively. The tank aft is 28 feet in diameter by 12 feet deep. Cones, measuring 6 feet in diameter at the bottom and graduating to 3 feet 6 inches at the top, are fitted into the center of each tank. The capacity of the tanks is about 25,500 cubic feet.

Each of the machines forward and that aft is provided with a dynamometer and lead to indicate the strain on the cable while it is being paid out or picked up, whichever the case may be. The dynamometers consist of the sheave with carrier sliding on a central turned tubular column. The column also acts as a dashpot and is filled with oil or soap water, in which a piston works. This mechanism is Messrs. Johnson & Phillips' improved design.

The cable is guided out of the storage tanks by opening bellmouths. As it emerges from these tanks it is led through a series of smaller opening bellmouths, fixed 18 inches above the deck, to the machines. In addition to the cable laying plant itself, there is a complete equipment of grapnels, buoys, anchors, chains, mushrooms, rock-cutting grapnels, and other accessories.

[Continued from SUPPLEMENT, No. 1287, page 20634.]

AMERICAN ENGINEERING COMPETITION.*

VIII.—STRUCTURAL STEEL WORK.

IN constructive steel work the Americans have made great advances during the last few years. This is putting the case very tamely, but one tires of writing superlatives about the American steel industry. It is better to let facts speak for themselves. The many miles of new railway yearly constructed in the United States demand a large number of bridges, and this alone is sufficient to give a great impetus to the production of steel. When we find one firm building for themselves a railway bridge across a river as wide as the Thames at London, simply to make communication between two of its factories, it is easy to suppose that bridges are not very expensive in America. The bridge in question has been already referred to as being made by the Carnegie Steel Company, who do a great deal of structural steel work in addition to making steel. Their Keystone Bridge works are, I believe—I have not inspected them—the largest establishment of the kind in the United States. It is one of the strong points of the American system that those who contract for structural work are largely producers of steel. The Carnegie Company have over a hunded draughtsmen in their Pittsburg office, and they will furnish designs for a building containing thousands of tons of steel, and make no charge for the design if they get the contract for the material. This is a marked contrast to our usual procedure with heavy architects' fees.

The big steel buildings of America have been too often written about to make any detailed description of them necessary here; but I doubt if many persons in England have an idea how completely in America steel is taking the place, not only of wood, but of brick and stone. One of these enormous edifices will contain 10,000 to 20,000 tons of steel, and will be 20 to 25 stories high. The framework is erected with marvellous rapidity, very powerful lifting appliances being installed by the contractors for the purpose. As all the parts are prepared accurately to size at the works, with holes drilled, they have only to be fitted together and a few rivets or bolts put in to make the skeleton of the house. I had a curious experience; for, arriving at a hotel, I saw out of my room window a substantial stone building; four days later this had entirely disappeared; in fact, the visible part went almost in a night. A little over a week after there was what appeared to be an enormous steel cage in the same place. This was the framework of the new building, fast working up to the 20 stories of its next door neighbor. The foundations of the new structure had been put in while the old one was being pulled down.

Steel erections of this kind are immensely strong, and, if properly designed, can be made into that rarest kind of structure, a really fireproof building. For this reason they are becoming more and more used for warehouses and for city edifices that are not exactly factories, but in which a good deal of machinery is employed, such as printing offices. I examined in Cleveland, Ohio, a typical building of this kind, designed by a firm of engineers, Messrs. Wellman & Seaver, of that city. The whole structural part was of steel, the walls being merely masonry panels filled in to give protection against the weather. As all the parts were riveted or bolted together—verticals and horizontals, columns, girders, beams, and joists—it would be almost impossible for the building to collapse in any circumstances. One could imagine a hundred times magnified Titan crumpling the whole thing up with a thousand-ton sledge-hammer, when, doubtless, the joints would give; but short of that it would stand almost any possible load. So far as the structure itself was concerned there was nothing to burn, but many inflammable things must necessarily be brought into a building of this nature. No structure will collapse more quickly under heat than a framework of naked iron or steel, and, therefore, the whole of the metal work was protected by concrete or terra-cotta bricks and tiles, with large spaces for the circulation of air.

It is to be hoped that something more may be done to introduce the steel building into this country, if for no other reason than to give an impetus to the steel trade. If our own steel-makers would take a leaf out of the Carnegie book and do something to force this outlet for their wares, instead of sitting still and lamenting their hard fate, it would be better for themselves and for the country. At present what little is being done here in this way appears to be mostly in the hands of Americans. When I was at Homestead last autumn they had just closed a contract to erect a big steel building in Edinburgh for the Scotsman.

The energy with which Americans "make" business is remarkable. Steel-makers are always trying to force people to use steel; they manufacture markets out of nothing. If an architect says he cannot put steel in place of wood, the steel-maker employs an expert to show it can be done. He does not sit down and abuse the architect for his want of enterprise, but sets to work to force his hand. That is how the Carnegie staff of designers of steel buildings was called into existence. Another notable instance of the creation of a market for steel is that of the Pressed Steel Car Works, which has been established to produce railway wagons on the Schoen system. A little more than three years ago not one pressed steel car was to be seen on any railroad, while at the time of writing 15,000 are in use. The business was started in 1889 in a comparatively small way; the different works of the company will now produce 130 cars a day. Their chief difficulty is at present to get steel. The management thinks itself fortunate in having made a contract, extending over a long term of years, with the Carnegie Company for the delivery of 30,000 tons of steel a month, or about 1,000 tons of steel a day, including Sundays. This, however, is but a part of the needs of the company, for according to the present demand for cars they could work up 1,500 tons of steel a day if they could get it. The factory at Allegheny City covers 24 acres, and has a capacity of 50 to 60 cars a day, the latter figure having been reached. On March 1, 1899, they purchased a farm on the opposite side of the river, and by the beginning of October of the same year had converted it into a pressed steel car factory larger than the one first built, its output being 75 cars a day. Both these factories are most elaborately fitted with steam and hydraulic machinery, compressed air plant, and a very complete equipment of electric cranes. The latter run at high speeds, the overhead travelers being capable of taking up a complete car and whisking it from end to end of the shops at 300 feet a minute.

The Atbara bridge created so much excitement that I naturally visited the Pencoyd Works, near Philadelphia, where that much discussed structure was made. It will perhaps be remembered that in Englaad it was considered impossible for this bridge to be produced in the time that elapsed between the giving of the order and its execution. One can easily understand that those who held this view considered they had unimpeachable ground for their statements if they took the resources at the command of a good many bridge construction works as their standard. The Pencoyd Works, however, are not ordinary bridge works, even for America. I was assured by Mr. Percival Roberts, the head of the firm, that there was nothing very extraordinary in the execution of the order, and that it was not true, as had been stated, that a bridge in progress had been diverted from its original destination. It is, however, unnecessary to reopen the controversy on the Atbara bridge. It is sufficient to say that the English contractors appear to have been put at a disadvantage by the action of the purchasing authorities; but, what is more to our purpose, the American firm accomplished what some of our engineers deemed simply an impossibility.

At Pencoyd they work continuously in 10 hours' shifts by day and 12 hours' shifts at night and use 170,000 tons of steel a year, to supply which they have eleven 30 to 35 ton open-hearth furnaces. There is also a Wellman tilting-furnace, a very remarkable invention, the arrangement being such that the whole furnace can be partially revolved, and the 70 tons of molten steel poured out, as one would pour out tea from a teacup. This tilting-furnace is a comparatively new invention which appears to be gaining ground rapidly in America. The Wellman-Seaver electric charging machine is used here for the open-hearth furnaces, and does much to facilitate operations and save labor—indeed, the manner in which labor is economized throughout, in the melting-house and the rolling-mill, and the erecting shop, goes far to account for the quickness with which work is turned out, and this rapidity is, in itself, a great source of economy in production. Electricity plays a very important part in supplying power for the various operations. The works are laid out so that from the time the raw iron is delivered at one end until it emerges at the other in the shape of bridges, etc., it is always moving forward, as each link in the chain of construction is forged. That, of course, is a recognized principle of good workshop arrangement, but recognized principles are not always followed. The rolling mills for producing the different sections of steel used in bridge and constructive work are thoroughly well equipped. The absence of men round the mill is a noticeable feature here as in other American steel works.

A feature of American practice worth noting is followed here. When it is needed to change rolls the whole machine, rolls, and housings, are removed by an overhead traveling crane. In this way rolls can be changed and work resumed in 1½ hours. It need hardly be said that the electrically-driven crane used for this purpose is one of very great power, and, therefore, an extremely costly machine. It is a striking example of the high value Americans place upon time and labor, and the way they appear to lavish capital expenditure to serve their ends in this respect. In the roughing mill the piece being worked is lifted between the presses by hinged hydraulic tables, while the horizontal

* This series of articles on American Industries was written by an expert of The London Times, who made an extensive trip through this country in order to prepare the articles, the first of the series being published in the SUPPLEMENT of July 21.

movements are electrically carried out, so no human labor is needed.

There are other features in the mill for saving labor and hastening work, but we must pass to the ground between the rolling mill and the bridge shop, where the rolled sections, beams, etc., are collected. The orderly arrangements here and the excellent transporting appliances account for a good deal of the economy of time, which is one of the leading features of these works. Every part of this stockyard is commanded by an electric crane, while the beams, etc., rest on electrically-driven "live" rollers, which will thus transport them to any part without labor. The bridge shop, where the parts are made up to form the finished structures, is a building 460 feet long and 200 feet wide, of one floor. The roof is a remarkable piece of work consisting of deep trusses extending over the 200 feet from wall to wall, but further supported by eight wrought iron columns placed longitudinally down the center. The roof, however, is only incidentally a roof; it is chiefly an enormous gantry to support the ways for electric overhead cranes which travel across or up and down the shop so as to command every part of the floor. These lifts and cranes are of different descriptions and range from a quick-running one-ton hoist to a 60-traveler. On the tools in the bridge shop a long chapter might be written, but only one or two of the most striking machines can be mentioned here. There is a big multiple punching machine, which will make ten holes at a stroke. The chief feature is that the holes may be spaced any distance apart up to 8 inches by shifting the punches, and this can be done by simply moving an index. There is a description of this remarkable machine, which was made by William Sellar & Company, of Philadelphia, in Engineering of November 24, 1899. What has been said will be sufficient to give an idea of how such a machine will expedite work when irregularly spaced holes have to be punched, as compared to an ordinary punch worked with a template. Another hole-making equipment that I cannot resist mentioning consists of three lattice-work gantries which will traverse along the shop on rails laid on the floor. On a top lattice-work girder is mounted an electric motor which actuates, through chain gearing, eight radial-arm drilling machines. There is room to place side by side for drilling four deep girders between the uprights of the machine. There is a 100-ton hydraulic riveter, which has an electric traveling gantry for carrying the work through it. The pneumatic tools are also of interest, as well as the system by which they are supplied with compressed air. Most of the machine tools are electrically driven, the more important by their own motors and the smaller ones have a motor common to a group. There are over 200 electric motors on the works, the current for which is generated in a central station. A point to be noticed is that the storage yard is served by two 40-ton electric traveling cranes, each of 60 feet span, and, as the gentries extend over the lines of both the Pennsylvania and the Philadelphia and Reading Railroads, it will be easily understood how little time is lost in loading.

The Berlin Iron Bridge Works, which are situated at Berlin, Conn., are as remarkable in many respects as the Pencoyd Works. I was first attracted to them by seeing in Berlin proper, that is, in the German capital, a large iron foundry which had been made at the Connecticut works and shipped across the Atlantic. Now the Germans have themselves made good progress in their steel-making practice, and are accounted to work cheaply; moreover, they are close buyers and patriotic, getting all they can in their own country. I was, therefore, a good deal interested in seeing works which could manufacture such a heavy thing as an iron foundry, pay railway freight on it from the middle of Connecticut to a seaport, pay freight across the Atlantic and then again further carriage from Hamburg to Berlin, and yet compete successfully with the German makers. The matter is more surprising, as Connecticut is not a steel-making State, and the Berlin company have to bring plates, angles, and other sections from a considerable distance. I asked Mr. Sage, the manager, to what he chiefly attributed his success in securing foreign orders. He thought it was principally due to making a study of the needs of their customers. "We must do it," he said, "or we could not live out here in Connecticut." For foundry work, for instance, though they have no foundry of their own, there is a special department, under the control of an expert foundryman, engaged solely in designing iron foundry buildings. The result is that, if the company are told how many castings of a given type are to be produced, they will supply a foundry laid out for the purpose. Accumulated experience, with a large number of similar works, must necessarily enable them to make a design that would include the latest and best practice.

This plan of employing experts for designing special plants and special factories is a great feature in the United States, and is worthy of attention. The Americans appear to be specializing in quite a different direction to ourselves. We have our Great George-Street magnates for designing bridges, roofs, etc., and the contractor, in theory, has simply to follow drawings and specifications. In America there are a certain number of designing engineers, but the work is far more in the hands of men who have had wide experience in the execution of work. Therefore, practice and theory—using the terms in their conventional sense—go more often hand in hand. I think the example we had in this country, not long since, of the design of an important bridge being recast by the contractor's engineer because it would have been impossible to erect it as originally planned, could not occur in America. In Westminster there are civil engineers who will design a whole railway in their office; bridges, stations, permanent way, locomotives, carriages—in fact, everything; and ill fares the impertinent contractor who suggests that any detail is capable of improvement. The consequence is that such designs are not designs at all, they are merely copies of former practice—methods and details pieced together to suit the occasion as well as may be; and thus progress is checked and the foreign contractor gets a footing.

On the other hand the British contractor, not being consulted, will not consult. He has to produce exactly what he is told, be it good or bad, and he seeks compensation in producing it in exactly his own way. Let us imagine a case in machine-shop practice by way of illustration. A locomotive maker may be planing his connecting rods, but a maker of stationary engines has found it is better to machine connecting rods by milling. But the locomotive maker will neither seek nor accept advice and goes on planning. That is a crude instance, but it is British; grossly British, no doubt. It is the sort of thing upon which we rather pride ourselves, but the qualities which held Ladysmith are not all that are needed for commercial success. The American is different. He sends a connecting rod to the machine tool-maker and says, "Can you design me a machine for this work, and, if so, how many will it turn out per week, and with what labor?" He knows the tool-maker has wide experience of what is being done in dozens of other shops in kindred branches, and he recognizes that all knowledge of the subject is not concentrated in his own brain. So it is that in the offices of the best machine tool-makers in America one will find quite a collection of curiosities—bits of engines, valves, cocks, boiler fittings, cycle components, all manner of domestic appliances, parts of ladies' dress furniture, firearms, hand tools, and dozens of other things. Although we have in England a larger and more influential class of engineers who sell only advice, I think, on the whole, very much more advice is sought in America. The broad difference is that British advice is manufactured largely in offices unconnected with works; in America it is chiefly the product of the workshop.

After dealing with the Pencoyd Works, I do not propose to refer to the plant of the Berlin Bridge Company beyond saying that it is excellent in all respects, the machinery being admirably planned and of the most modern description. The organization for keeping track of drawings and of the large stock of steel always on hand has been most carefully thought out. Moreover, the checking of measurements and calculations is so well looked after that work is never erected before leaving the yard, and the different members of a bridge in building do not come together until they are on the site. The Berlin foundry, to which reference has been made, went together like a child's puzzle, without a hole having to be drilled on the spot. A day or two before I visited these works there was an account in the papers of a railway bridge accident. A heavy goods train had left the rails on a bridge and so injured one of the members as to render the structure unsafe. The bridge was one of the Berlin Company's construction and the accident happened in the afternoon. Word was telegraphed to the company, and forty-five minutes after receiving the message a template for the new work was made. A member to replace the injured one was sent off by a fast train, and, by dint of working by the electric light all night, the bridge was ready for traffic again the morning following the accident.

This company employ day labor, piece work not being the practice. They have, however, an efficient system of checking work turned out by means of cards, and if there is any slacking off, the foreman is held responsible, a foreman who cannot keep up to the standard not being considered fit for the post. The system acts well, although work is carried on continuously, there being a day and a night shift, each of ten hours.

CONTEMPORARY ELECTRICAL SCIENCE.*

ANOMALOUS ELECTROMAGNETIC DISPERSION.—As in optics, so in the domain of electromagnetic radiation, the angle of refraction varies with the incident wave-length. In some chemical substances the dispersion does not vary continuously with the wave length, but changes abruptly at certain points, and then we have anomalous dispersion, as in the solutions of certain copper and chromium salts, and, according to Kundt, in iron, nickel, and cobalt. Recent researches have shown that these anomalies are invariably found in the neighborhood of absorption bands, and the experiment of Macaluso and Corbino, first supposed to indicate an inverse Zeeman effect, has since been connected with the anomalous dispersion of sodium vapor in the neighborhood of the D lines. A. Schmauss has made some measurements of the electromagnetic rotatory dispersion in the fuchsine solutions and in didymium glass which justify the general conclusion that optical anomaly in dispersion is invariably associated with electromagnetic anomaly. In strongly absorbing media the anomaly extends for a considerable distance on both sides of the absorption band, and it increases with the concentration and with the narrowness and sharpness of the absorption band.—A. Schmauss, Ann. der Physik, No. 6, 1900.

MAGNETIC ROTATORY POLARIZATION IN LIQUEFIED GASES.—The continuity of the optical properties of substances under different circumstances as to pressure and temperature, especially during changes in the state of aggregation, is an important point of investigation on which light can be thrown by measurements of the Faraday effect. The molecular rotary constant will generally depend on pressure and temperature and will vary considerably with the state of aggregation. Becquerel made some measurements in which he found that during the transition from the liquid to the gaseous state the magnetic rotation of carbon bisulphide decreases much more rapidly than the density. This would indicate that the Faraday effect is practically confined to liquids. L. H. Siertsema has begun a series of experiments with a number of liquefied gases which promises some interesting results. Many difficulties have to be surmounted, such as the formation of bubbles owing to a slight conduction of heat. This necessitates additional protecting glasses, and consequently larger rotations to compensate increased inaccuracy. The author uses the Arons's mercury arc lamp, and begins with methyl chloride at $-23°$. Preliminary measurements show that the dispersion, at all events, is of the same order as that found in the gaseous state.—L. H. Siertsema, Proc. Roy. Acad., Amsterdam, May 26, 1900.

SPARK-LENGTH OF AN INDUCTION COIL.—R. Beattie has studied the effect on the secondary spark-length of using different materials for the primary poles, and of varying the rate of break and the E. M. F. in the primary circuit. In place of the usual vibrating interrupter a special contact-breaker was employed, by means of which the primary poles could be separated either slowly or quickly, as desired. As regards the material of the poles, platinum gives a much longer spark than either lead or carbon. This is no doubt due to the fact that carbon is more easily disintegrated, and sets up an arc which bridges the gap. A quick break gives a long spark, and a slow break a short spark. As a rule, a high E.M.F., by prolonging the arc, gives a shorter spark in the secondary. But this is not the case with carbon, zinc and lead poles and a slow break. The "best capacity" for increasing the length of spark also depends upon the rate of break, decreasing as the break is quickened. In the case of zinc, however, it increases, and for certain capacities a quick break may actually give a shorter spark than a slow break. This peculiar behavior of zinc when used as a brake-pole is probably connected in some way with its non-arcing properties.—R. Beattie, Phil. Mag., July, 1900.

THERMO-ELECTRICITY OF NICKEL STEEL.—The announcement of the high thermo-electric force of nickel steel containing 28 per cent. of nickel having given rise to some doubts, C. E. Guillaume forwarded an authentic sample of such steel to E. Stiennmann for redetermination. The latter announces now that the phenomenally high value of —2,461 microvolts with reference to lead is not shown by the authentic specimen, which only shows 385 microvolts. The old specimen turns out to have been wrongly labelled. It should have been marked as containing 36·1 per cent. of nickel.—E. Stiennmann, Comptes Rendus, July 2, 1900.

INTERCEPTION OF WIRELESS TELEGRAMS.—No system of limiting the receipt of wireless messages has as yet been described, though the solution of the problem has already been several times announced. D. Tommasi suggests a plan which appears feasible enough, though it only reduces the space within which a given message can be received to a spherical shell instead of a line or a point. The idea is to use two transmitters of different ranges of action. The transmitter with the larger range is used for sending the message to the station for which it is intended, while the transmitter with the shorter range is employed in confusing the message within that range by an unmeaning series of dots and dashes. The range of a transmitter can fortunately be adjusted by altering the size of the spark gap, and thus it should not be difficult to restrict the chances of interception to a zone of, say, half a mile. If, in addition, the spherical wave train could, by reflection or otherwise, be converted into a beam of the form of a searchlight, the problem would be solved in a way. But, of course, a very much more satisfactory solution would be a device of the lock-and-key kind, in which messages could only be received by an instrument of very special construction and dimensions.—D. Tommasi, Comptes Rendus, May 14, 1900.

MAGNETIZED COHERERS.—The coherers with magnetic electrodes devised by C. Tissot (see The Electrician, May 5, p. 41) have been applied with great success to the exchange of wireless messages between French battleships and the Port Zic lighthouse. The most interesting feature of the contrivance is that it does not contain any of the devices patented by Marconi. The height of the masts did not exceed 100 feet, and good signals were obtained at a distance of 33 miles. The coil employed for transmission was a transformer by Wydts and Rochefort. The messages exchanged were complete phrases, telegraphed by the ordinary Morse code and read by the ordinary ship telegraphist on board. The filings on the coherer and the iron terminals are kept very dry, and are best enclosed in a tube hermetically sealed and containing a few fragments of calcium carbide. The E.M.F. of the circuit may be varied within wide limits without interfering with the clearness of the signals. The ordinary resistance of the coherer is from 200,000 to 500,000 ohms. At coherence, it falls to something between 1,500 and 3,000 ohms. The fall of resistance in magnetized coherers is not entirely due to the impact of the waves. The increase of the current strength itself brings about a further fall.—C. Tissot, Comptes Rendus, May 21, 1900.

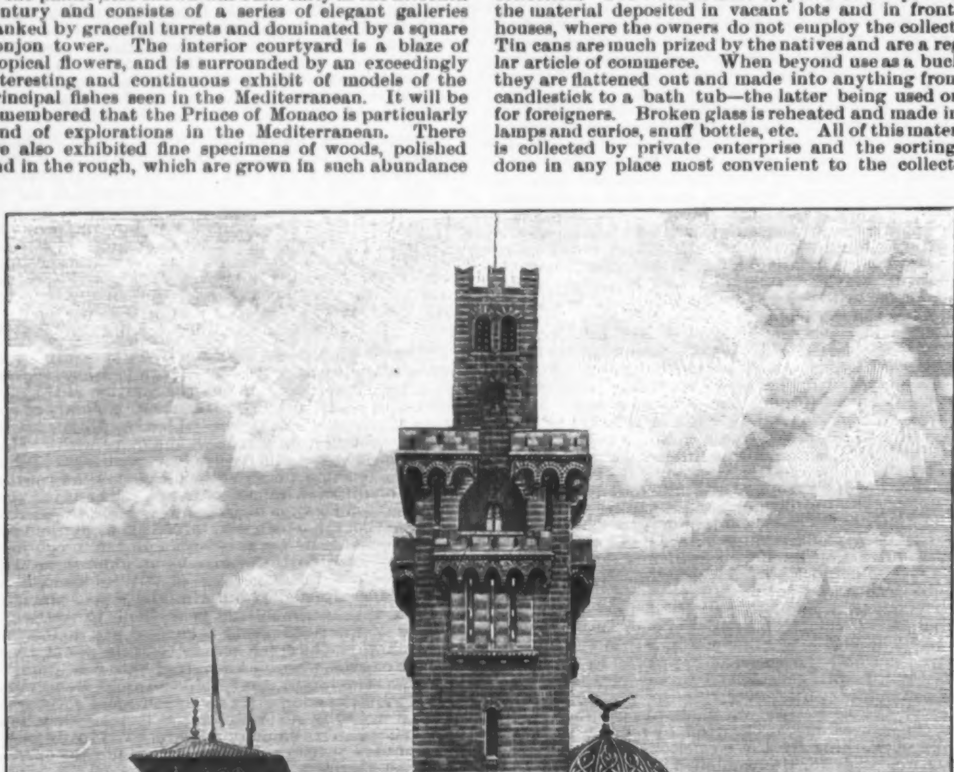
ELECTRIC PENDULUM.—An electrically-driven pendulum should, according to Lippmann, fulfill the following conditions: The restitution of kinetic energy should take place when the energy is all kinetic—i. e., when the pendulum passes through the vertical; the "electric sticking" should be abolished—i. e., the adhesion between two points at which the circuit is broken; the isochronism on the pendulum must not be disturbed by the electric contact; and the quantity of energy imparted at every oscillation must be constant, and independent of the state of the battery. Most of these conditions are fulfilled by a pendulum designed by C. Fery. A permanent horseshoe magnet is attached to the bob of the pendulum, and one arm of it passes at every swing into a coil through which a constant quantity of electricity is sent just at the moment at which the pendulum is passing through the vertical. The manner in which the constant quantity of electricity is obtained from a possibly inconstant battery is very ingenious. A balancing arm bears at its ends two coils which fill up the spaces between the poles of two horseshoe magnets. The arm is of soft iron, and when a current traverses either of the coils it is temporarily magnetized. One of the coils is the "motor" coil, and receives the current from the battery. It is attracted by the electromagnet against the force of a spring, and thus brings about a definite displacement of the other coil in its magnetic field. The induced current caused by this displacement traverses the coil which receives the magnet attached to the bob, and thus gives to the latter the impulse required. With an E.M.F. of 10 volts, the current required is only of the order of a milliampere, and the amount of zinc consumed in a whole year would not exceed 20 grammes. Even so, however, the "efficiency" of the apparatus is very small, considering that the power required is only a forty-millionth of a horse power.—C. Fery, Comptes Rendus, May 7, 1900.

* Compiled by E. E. Fournier d'Albe for The Electrician.

Liquid Bronze is produced as follows: Mix 100·0 of powdered damar-resin with 30·0 of calcined soda and heat, with occasional stirring, for two to three hours until melted. Over the cooled and well powdered molten mass pour 900 c. cm. of benzine, shake repeatedly, and filter off from the undissolved parts. With the filtrate mix 200·0 to 300·0 of bronze color.—Journal der Goldschmiedekunst.

THE PAVILION OF MONACO AT THE PARIS EXPOSITION.

The Pavilion of Monaco at the Paris Exposition is on the "Street of Nations" and is between the Spanish and Swedish pavilions. It is an admirable reproduction of the celebrated Palace of the Grimaldi, which forms one of the most attractive features in the foreground of the magnificent panorama of which the Casino at Monte Carlo is the keynote. The part of the palace here shown was built early in the fifteenth century and consists of a series of elegant galleries flanked by graceful turrets and dominated by a square donjon tower. The interior courtyard is a blaze of tropical flowers, and is surrounded by an exceedingly interesting and continuous exhibit of models of the principal fishes seen in the Mediterranean. It will be remembered that the Prince of Monaco is particularly fond of explorations in the Mediterranean. There are also exhibited fine specimens of woods, polished and in the rough, which are grown in such abundance in the smallest principality in the world. The walls of the interior are covered with scientific maps loaned by the Prince and show the results of the studies he has made while on his numerous scientific voyages in his yacht "The Princess Alice." The galleries of the loggia are decorated the same as those of the Palace of Monaco. The arms of the principality are conspicuously placed over the principal door. For our engraving we are indebted to The Monde Illustré.



THE PAVILION OF MONACO AT THE PARIS EXPOSITION.

GARBAGE DISPOSAL IN CHINA.

Some time ago the Agricultural Department became interested in the study of the disposal of garbage, sewerage, etc., in foreign cities, and solicited the aid of the State Department in obtaining information. The department directed the consular officers of the United States to forward all information obtainable.

An uncanny tale comes from Consul Fowler, that makes the reader feel creepy. He says:

"The cleanest cities in China are Hang-Chow and Ning-Pox. In the center of those two cities I have myself seen dogs eating bodies of babies; the rotting corpses of cholera cases; snakes slowly winding in and out; many dogs, slime, dead cats; in fact, the most horrible filth on one side, while across the way the glitter of gold, pomp and luxury; such are the principles of a Chinese street. The garbage collector is the beggar or the starving dog."

Consul Ragsdale writes from Tien-Tsin that "all animal food is comparatively costly and the mass of the people are poor. The methods are from house-to-house collection. The work is done by private enterprise and the material deposited in vacant lots and in front of houses, where the owners do not employ the collector. Tin cans are much prized by the natives and are a regular article of commerce. When beyond use as a bucket they are flattened out and made into anything from a candlestick to a bath tub—the latter being used only for foreigners. Broken glass is reheated and made into lamps and curios, snuff bottles, etc. All of this material is collected by private enterprise and the sorting is done in any place most convenient to the collector. Household waste waters are thrown into the empty pools at the side of the streets and eventually this water is used for street sprinkling. The streets and the passers-by are sprinkled by means of long-handled ladles.

"The street refuse collections are made by men and boys with a basket and a small long-handled ladle or shovel. The basket hangs on the back from the left shoulder and great skill is shown by some collectors in scooping up everything and throwing it into the basket without loss. This material is taken to some bright, sunny and convenient locality, mixed with two parts of street dust and made into cakes, the size of an orange. These cakes are sun-dried and sold as fertilizers. The most convenient place for a foreigner to study the details of these methods is the stone bridge on Legation Street. It is only a few hundred yards from the two foreign hotels and the French, German, Japanese, English, Russian, and American legations. The bridge, being thus centrally located with a windswept stone floor exposed to the sun, possesses all the requirements of a first-class fertilizer dryer. It is in daily use. The sewage system of Peking is certainly a combined system. Everything combines in the streets. No filters are used. The supply of street sweeping exceeds the demand by about three inches in depth."

STRIPPING NEGATIVES.

The advantage of being able to strip the film from its glass support and to transfer it to another glass plate or to celluloid, or to strengthen it for storage and use as a flexible film are so palpable in many of the serious applications of photography that a very practical article on the subject in the Photo-Midi (here translated) is worth the attention of every reader who has hitherto regarded stripping as an operation too risky to be performed on valued negatives. The aforesaid advantages are, of course, the production of direct pictures by single transfer carbon, powder, and ceramic processes; in stereoscopic work, the making (from a reversed negative) of the stereo print direct, without the trouble of transposition before mounting; in the readiness with which bromide paper can be used for the negative, and the film transferred to glass or other support after fixation; in the various photo-mechanical processes, such as collotype, etc.

Many of the formulæ and recipes given for stripping are complicated, or require delicate manipulation, or are even dangerous, requiring the use of hydrofluoric or hydrochloric acid. Success with many of them is very doubtful. Then, again, with many the film unrolls itself in the stripping bath, thereby undergoing enlargement and necessitating extra density of the original negative. The following method possesses none of these disadvantages.

The plate having been washed in the ordinary way, and while still wet, is placed in the following bath, which is kept gently rocking during the period of immersion (one minute):—Water, 100 parts; formalin, 30 parts; glycerine (pure), 4 parts. It is then removed and set to dry just as it comes from the bath.

If the film to be stripped has been allowed to dry previously to treatment in this bath, it should be softened in water by soaking for at least half a day. It is then treated as above, with the exception that the time of immersion should be three or four minutes, instead of one. This softening of the gelatine can be dispensed with if the immersion should be three or four minutes, instead of one. This softening of the gelatine can be dispensed with if the immersion in the formalin bath be prolonged to ten or fifteen minutes, but the first of these methods is the best.

Once dried, after treatment with the formalin, the negative must be given one or two coats of a celluloid varnish, the second being applied only after the first is quite dry. These coats being quite dry, the film is cut round the edge with a penknife an eighth of an inch or so from the edge of the plate, inserting afterward a thin blade of the knife slightly under the film so as to release the edge. It can then be drawn gently away, leaving the glass with an enamelled surface, such as is obtained when P.O.P. prints are glazed. The negative is thus obtained in a form which is sufficiently rigid for all ordinary requirements.

In place of celluloid a film of collodion (or gelatine solution, applied warm) can be used. The solution is flowed on the ordinary collodion and set to dry and harden in a horizontal position. But, unfortunately, the strengthening qualities of these two films are not sufficiently pronounced, and, moreover, the duplex film produced is liable to expand and contract with changes in the hygroscopic condition of the atmosphere, and in very damp weather to adhere to the gelatine surface of the printing paper.

If it is desired to make the stripped film thicker, or to protect it from accidental injury by liquids or gases, or to insure its preservation for an indefinitely long time (for formaline does, in course of time, modify the physical properties of gelatine which has been submitted to its action), the film can be sandwiched between two layers of celluloid. In order to accomplish this, the film, which has been coated on one side and detached from its glass support, is laid on a flat surface (gelatine side up) secured so that it does not curl up, and a coat of the varnish applied. Another method of adding this second protecting face—more complicated, but, on the whole, better—is to strip the film from glass as before, to wash it, and to soften the gelatine in water containing glycerine. It is then, while under water, brought into contact (gelatine side down) with a clean glass plate, coated first with celluloid varnish, to which has been applied (after drying) a film of enamel collodion. In order to insure the success of this operation, it is necessary to lay the negative on the collodion-coated film of celluloid just as the collodion is "drying," i. e., the plate is immersed just before the solvents have completely evaporated. All that then remains to do is to dry, cut round, and remove the film. The resulting pellicle is much more rigid, and at the same time impermeable by most liquids.

The celluloid varnish consists of celluloid dissolved in amyl acetate, to which 20 per cent. of acetone is added. This is used in the cold; dries rather slowly, so that the films should not be stripped or a second coat of the varnish applied until at least twelve hours after the application of the first.

The period of drying can be shortened by incorporating a certain quantity of collodion varnish. This is ordinary collodion, or the thick collodion of the pharmacist, in which only absolute alcohol is used. The writer prefers, however, to wait longer and to use only pure celluloid, thus securing the great impermeability which characterizes this substance, a property which is diminished by addition of collodion to the varnish. The celluloid varnish has many qualities which recommend it. It is transparent, adheres with great tenacity, is easily and rapidly prepared, withstands wear, does not scale off, and completely protects negatives (any retouching done on them) from the spontaneous destruction to which, sooner or later, they are doomed.

In preparing it, spoilt Blair or Eastman films can be deprived of their gelatine coating, well washed, and used as the staple of the varnish. The principal advantages which negatives in film form have over those on glass may be enumerated in conclusion:—Lightness, non-fragility, compactness, portability, flexibility (no breaking of negatives in the printing frame), printing from either side. These, and the points which are mentioned at the commencement, encourage the writer

to hope that photographers will not hesitate from any imagined difficulty of the process to filmize their negatives.—The Amateur Photographer.

THE TREATMENT OF GOLD ORE AT THE TRANSVAAL EXHIBIT AT THE TROCADÉRO.

FROM a technical viewpoint, one of the most interesting exhibits at the Paris Exposition is undoubtedly that of the exploitation of gold ore installed in special buildings erected on the right hand declivity of the Trocadéro. This exhibit is made by the government of the South African Republic, but at the expense and under the surveillance of the Chamber of Mines of the Transvaal, which, moreover, is to assure the proper operation of it for the entire period of the Exposition.

The great importance of the gold industry of Southern Africa and the constantly increasing progress that it has been making in recent years is well known.

The total value of the gold extracted from the mines of the Transvaal from 1884 to 1899 amounts to $428,341,884. As may be seen from the following figures, which show the last annual productions, the progression increases in a peculiar manner:

1887	$ 845,474	1894	$38,719,117
1888	4,885,451	1895	43,276,253
1889	7,527,368	1896	43,449,292
1890	9,441,706	1897	58,851,311
1891	14,797,747	1898	82,015,181
1892	22,932,408	1899..More than	100,000,000
1893	27,676,515		

It was, therefore, of interest to show to the public at large the processes employed for the extraction of gold from the ground and the phases of the exploitation of the ore.

The first part of this work we see in the mining exhibition of the Trocadéro; the second, as above stated, is installed at the surface. These two exhibits, as we have said, are made under the auspices and at the expense of the Chamber of Mines of the Transvaal, whose representative at Paris is M. J. G. Bousquet.

FIG. 1.—THE FURNACE BUILDING AND GOLDEN MONUMENT.

The auriferous quartz ore is brought from the Transvaal and deposited in the cellars of the two buildings in which the different machines are placed.

The first operation to which the crude ore is submitted after extraction from the earth is that of separating the quartz from the gangue. This operation is performed by hand upon large annular tables. None of this is seen at Paris, since the ore is brought hither already separated, in order to diminish freight charges. But a well executed painting, made in situ, shows all the details of the operation with the greatest accuracy.

The buildings of the Chamber of Mines at the Trocadéro consist of two parts, separated by a court. The operations are performed partially in the buildings themselves and partially in the court (Fig. 2).

The ore is raised by an elevator from the cellars to the top of the building in order to permit of its being passed through the different apparatus with sufficient gravitation to assure the outfall of it. This elevator, which has nothing in common with mining apparatus, is provided with members that assure the automatic stoppage of it. It is a very simple American machine, called a worm-gear elevator. Its cable winds around a large drum, the rotary motion of which actuates a screw that causes a collar to ascend or descend. Upon the axis of this screw there are two disks, the position of which may be varied, and that are designed to engage with the collar of the screw at the moment of contact. A groove of special form on the surface of the two disks imparts motion to a lever arm that shifts the driving belt from the loose to the fast pulley, and vice versa. From this it will be seen that by properly regulating the two disks it is possible to bring the drum to a standstill at points that correspond exactly to the beginning and end of the ascent of the elevator. This automatic apparatus is very convenient, since it dispenses with the intervention of a workman for the arrest of the platform of the elevator.

This elevator, as well as all the apparatus of the installation, is actuated by the electro-motive current of the Exposition; but, in order that no delay may be suffered, a 32-horse power gas motor sufficiently powerful for all the exigencies of the exploitation has been provided.

The ore is shoveled into small cars, which are run on to the platform of the elevator, raised to the top of the building, and then shoved toward the orifice of a hopper, into which the contents are dumped, and which directs them to a Black-Marsden crusher, the object of which is to reduce the quartz to small fragments. This apparatus consists of jaws that come together with great force, and thus crush the material that falls between them. One of its advantages is that the jaws may be easily replaced in case of accident or breakage.

The fragments of ore pass into a second hopper, whence they are led by a long chute to a feed distributer, the object of which is to assure a continuous and constant discharge. The quartz next enters a mortar or stamp. This latter is a sort of long cast iron trough containing water. Five pestles reduce the fragments of ore to dust, which mixes with the liquid and forms a very fluid mud called "pulp."

The most important operation to be performed for the gathering of the gold from the pulp is amalgamation. This begins in the stamp itself, although for a very small fraction of the total operation. To this effect, a few globules of mercury are allowed to fall into the trough. The operation is continued upon a large table 12 or 15 feet square covered with sheet copper that is carefully amalgamated with mercury every twenty-four hours. The pulp spreads over this table after making its exit from the stamp through a sieve. The amalgam of gold formed upon the surface of the copper is collected and ultimately treated. It contains about fifty-two per cent. of the gold of the ore.

But let us continue to follow the passage of the pulp and see what becomes of it. It first passes into an apparatus called the Frue vanner, which consists of a rolling belt of rubber five feet in width actuated by two parallel drums spaced about ten feet apart. The upper surface of this belt is inclined in a direction reverse that of its motion. As the apparatus is submitted to transverse motions, the pulp becomes divided into two elements: On the one hand, into pyrites, rich in gold, which are carried along by the motion of the belt and fall into a receptacle provided for the purpose, and, on the other, into an impoverished pulp, which is very liquid and flows in an opposite direction, on account of the inclined position of the apparatus. This pulp is led through a wooden conduit to certain points where it is to be submitted to other operations, while the pyrites are treated by chloruration or cyanuration, although not at the Trocadéro; for want of space. The pyrites are sold to special works, which extract the gold therefrom.

The impoverished pulp is led from the first building, through the wooden conduits mentioned, and is emptied into buckets of a large revolving elevator, which raises it to a large, circular, flat-bottomed iron plate reservoir, wherein it separates into two parts—a liquid one called "slime," which flows out through apertures of variable level, and a thick one, which remains at the bottom of the reservoir. This latter portion constitutes the "tailings," or "auriferous sand."

As a general thing, the slime, which contains a little gold, is submitted to treatment, but at the Trocadéro it is allowed to flow into the sewer, because there is not sufficient space to permit of its being handled.

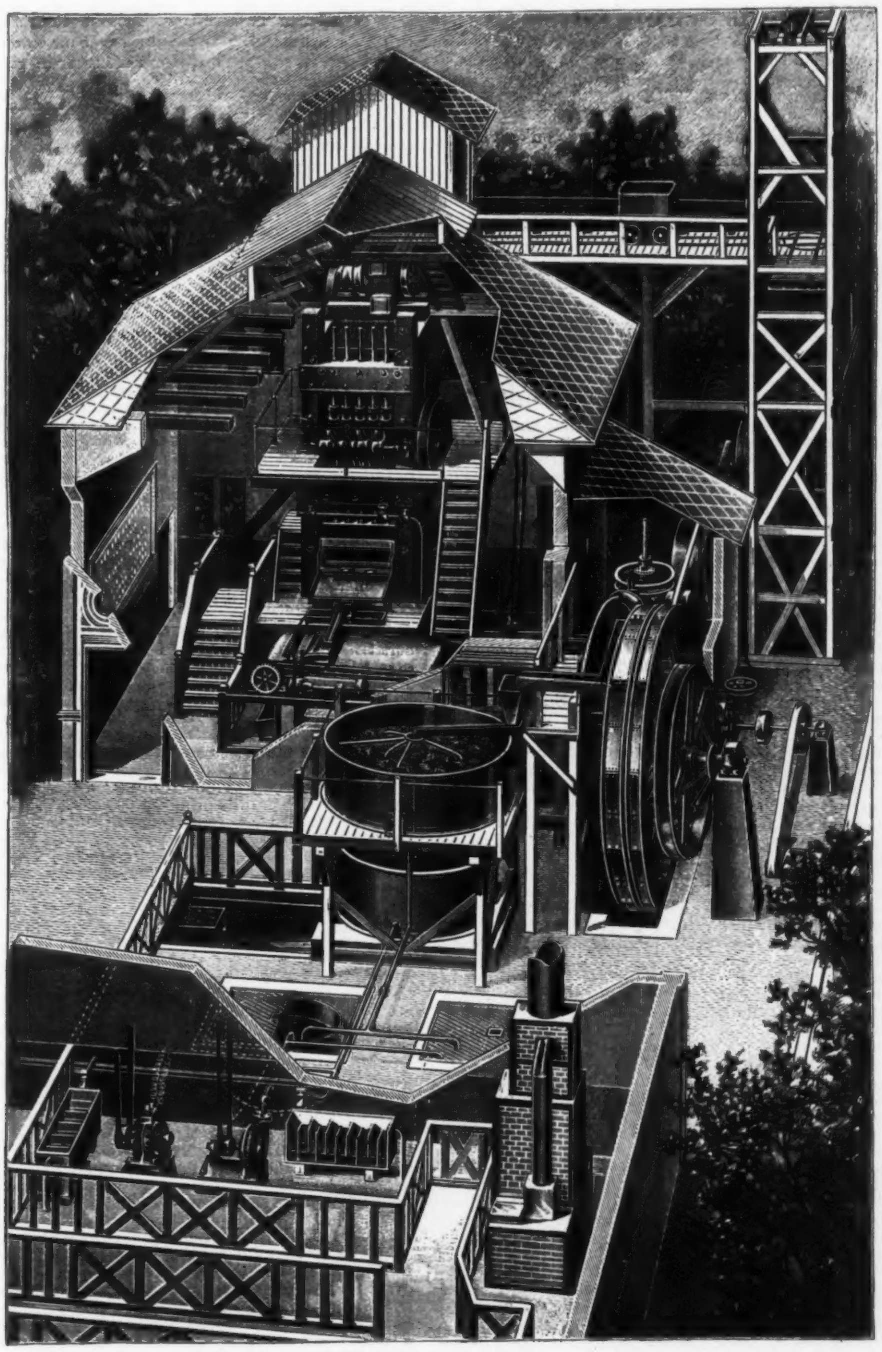


FIG. 2.—GENERAL VIEW OF THE TRANSVAAL INSTALLATION FOR TREATING GOLD ORE.

The tailings fall through a trap into a reservoir similar to the one just mentioned, and in which the cyanuration is effected. The cyanide of potassium used in the operation is kept in solution in iron plate reservoirs, whence it is forced by means of pumps up to the surface of the tailings contained in the circular reservoir. This liquid traverses the sand and dissolves the gold on its passage. At the bottom of the reservoir there is a filter which retains the sand that has already been submitted to the action of the cyanide of potassium and that contains no more gold. The cyanide of gold and potassium passes through the filter and is received in pipes that lead it to the second building of the Trocadéro installation. The cyanide is then sent into boxes divided into compartments, wherein the gold is retained by zinc filings, and a double cyanide of gold and zinc is formed. This zinc slime, as it is called, is treated with sulphuric acid and boiling water, so as to form soluble sulphate of zinc and to set the gold free. The gold is then collected in a filter press, refined, and cast into ingots.

The zinc slime is not treated at the Trocadéro on account of the acid disengagements that accompany the operation. It is sold to special works.

It will be seen that of all our products there remains only the amalgamated gold obtained at the beginning of the operations, since the pyrites, slime and zinc slime are not treated at the works under consideration. All that is done is to place the amalgam in an earthern retort and distill off the mercury by means of a long tube that plunges into water. The gold that remains in the retort is refined and cast into ingots.

All these operations are performed before the eyes of the visitors, who are enabled easily to understand them through the aid of large pictures that hang upon the walls and clearly explain the different phases of the treatment.

Speaking in a general way, it may be said that the working of gold ore is reduced to two great operations, viz., amalgamation and the cyanuration of the sand and pyrites.

The quantity of gold collected by these two operations may be grossly divided as follows:

Amalgamation	52
Cyanuration of sand and pyrites	34
Loss	14
	100

Alongside of the works above mentioned there are two small isolated buildings. In one of these are seen models of mining works, with all the materials employed, while in the other is installed a wonderful relief map of Johannesburg and its neighboring mines—the Robinson, the Deep Robinson, the Central Deep Robinson, the Worcester, the Ferreira, the Deep Ferreira, and the Wemmer. Upon this map we find all the buildings of the city and of the mining exploitations, as well as all the apparatus installed at the surface.

Let us add that a large monument of gilded plaster standing in the garden (Fig. 1) gives only a good idea of the auriferous production of this rich country of Southern Africa, presenting, as it does, a synthesis of the value of the gold extracted in recent years in the Transvaal.—For the above particulars and the illustrations we are indebted to La Nature.

INDIA RUBBER AT THE PARIS EXHIBITION.

It cannot be said, says Engineering, that the general arrangements of the Exhibition have met with the approval of such visitors as have gone to Paris this summer to improve their knowledge of this or that manufacture; and particularly is this the case with the India rubber exhibits, which are not, as in the last Exhibition, to be found all together, but are scattered up and down, some on the Esplanade des Invalides, some on the Champ des Mars, to say nothing of various pavilions, where rubber (either raw or manufactured) forms part of the national exhibits. To some extent the rubber exhibits are collective, as in the Caoutchou and Gutta-Percha Section of French Industries on the Esplanade des Invalides, while in other cases they are distributive, and have to be sought for, not under the heading of "Country," but under such heads as "Electricity," "Automobiles," "Clothing," "Surgery," and "Chemical Manufactures." It will easily be seen that when you begin to split up rubber exhibits, it is very difficult to know where to stop, so multitudinous are the uses to which rubber is put, and so many are the goods in which it forms one of the component parts. Of course, the authorities of such an Exhibition as this, which practically deals with the world and its products, have been confronted with difficulties as to classification which were practically non-existent in the case of recent continental exhibition, such as those at Berlin in 1896 and Leipzig in 1897; and it is unreasonable for those who are entrusted with the task of reporting upon the exhibits to expect that they will find their work as free from difficulty as if they were reviewing the products of a single nation or a single province. All the same, we are disposed to indulge in a little grumbling by way of neutralizing the feeling of irritation which the arrangement of the exhibits now under review has engendered; and we are the more emboldened in this course of action by the knowledge that our opinion is shared by others.

An English rubber manufacturer, on his return from Paris, was asked what he thought of the rubber exhibits, and his reply, uttered in a tone expressive of disappointment, was: "There is no rubber; at least there is nothing which cannot be seen in the shop windows." Now, we cannot agree that there is no rubber, for there is a great deal; practically every article which is made of rubber alone, or into which rubber enters, being on show; but that there is a total lack of novelties is an indisputable fact. In saying this, we are speaking, of course, from the point of view of the trade, and not of the "man in the street," who, whatever he may know about the conduct of wars, is, as a rule, profoundly ignorant of the branch of technology we are discussing.

The last twenty years has seen a great increase in the volume of the rubber trade, and, moreover, it has seen its establishment as an important business in countries formerly supplied from England; but the rationale of the manufacture has undergone no striking change; important discoveries, such as those of Macintosh and Goodyear, the former of whom founded, and the latter of whom revolutionized the trade, have been conspicuous by their absence, and progress has been made in the application of rubber to new purposes, as in the cycle industry, rather than by the adoption of new methods of manufacture.

With regard to the show which is being made by the countries who are foremost in this manufacture, it has to be recorded that the American exhibits, which were to have been on a large scale, are absent. A year ago a good deal was heard in trade circles about the comprehensive character of the show which the United States firms were going to make, under the personal direction of the editor of The India Rubber World, but since then the scheme has been abandoned, primarily owing to the action of the "rings" which have been formed in the trade in the States.

Beyond one or two rubber insulated cables, the visitor will find nothing to give him an idea of the importance of the American rubber trade. Much the same thing must also be said with regard to Germany and England, the German trade having, without exception, abstained from exhibiting, while England shows up very poorly, nearly all her leading manufacturers being absentees. Whether this is due to the Dreyfus case or not is a matter we do not care to express an opinion upon; moreover, we are concerned here with the Exhibition as we find it, and not with what we expected to find; but it is permissible to express some surprise at the abstention of the Germans, who are now such large manufacturers of rubber goods, seeing that they show up so well in other branches, and, moreover, are visiting Paris in large numbers this year. That political considerations have had some influence upon the abstention of the British is quite possible, but we are not inclined to admit that this is the sole cause. In 1878 the British firms were able to show the world a good deal about the rubber manufacture, and the Continental firms undoubtedly gained several hints which they were not slow to avail themselves of. As the trade is to-day, the British firms would have had very little of novelty to show if they had decided to enter the lists at Paris, and that fact may have had some weight in determining their course of action.

The exhibitors, as a rule, strike us as being rather laconic with respect to the utilization of the possibilities which such an exhibition naturally holds out in the way of attracting new business. In but few instances are any attendants present to give information to those desirous of it, and even the ordinary custom of affixing business cards to the outside of the cases is by no means universally adhered to. In nearly every case descriptive labels (in French only) are attached to the goods, though a prominent defaulter in this respect is the Silvertown Company, the exhibit of whose general rubber goods from the Persan Works contains no letterpress whatever. Whether this lack of attendants is due to consideration of expense, or to a feeling that their presence would serve no useful purpose, we are unable to say; but it seems to us to be a somewhat short-sighted policy. Leaving out of consideration the representatives of the press, who, if they have unlimited time to make appointments at various offices in the city, may obtain any information which the exhibitors care to give, it will be acknowledged that business men from afar, whose time to view the Exhibition is perhaps very limited, may reasonably indulge in a growl at their inability to learn more than is revealed by cursory glances through panes of glass. Possibly we are attaching too much importance to a small matter; but it is noticed, in accordance with the general scheme of these notes, which we propose to present in the form of a critical summary rather than as a cut and dried catalogue of exhibits.

Though we take no responsibility for the truth or otherwise of the statement, the English manager of one of the prominent French India rubber exhibitors recently said that compared with his experience of English manufacturers, the French were tardy in opening up new business; they were shy, he averred, in making developments in view of possible failure. An American expert, who recently visited several of the rubber works of England, France, and Germany, expressed his surprise at the comparatively limited scope of the manufacture as carried out at the numerous French works. That France is capable of producing almost everything that is made of rubber is seen at once when one enters the Rubber and Gutta-Percha Section of French manufactures. Here no less than thirty-four firms display their goods, though it should be said that among the number are some who are merchants only and not manufacturers. It is noticeable, however, that among the exhibitors several are makers principally, if not entirely, of one or two classes of goods, a feature which differentiates the French manufacture to a great extent from that of England, Russia, and Germany, in which countries there are large firms making almost every variety of rubber goods, and on an imposing scale. Such colossal works, among which may be mentioned the North British Rubber Company, Charles Macintosh and Company, Limited, Moseley & Warne, of Great Britain; the Continental Rubber Company, of Hanover, the Berlin-Frankfort Rubber Company, and the Harberg-Vienna Rubber Company, of Germany; the Russian-American Rubber Company, of St. Petersburg, and the Russian-French Rubber Company, of Riga, are represented at Paris only by the two last named, if we except the Silvertown Rubber and Telegraph Works, whose exhibits apply to their French and not their English works. Not to do Italy an injustice, we ought to include the firm of Pirelli among the giants in the business, so great has been the progress which they have made in almost every branch of the rubber manufacture of recent years, but we shall have more to say about the Italian industry later on.

A class of goods, the manufacture of which originated with the French, we refer to India rubber toys, is very well represented among the French exhibits. The progress that Germany and Russia have made of late in this department is considerable, though the British firms seem to be actuated by the same spirit which to a query on the subject put to a Canadian rubber manufacturer, brought forth the reply, "Rubber toys! no, we don't bother with such things, there is not enough profit in it." It was noticeable that the exhibits of toys attracted more attention from visitors, juveniles at any rate, than did the neighboring exhibits which, perhaps, rather too much represented shop windows. If we may say so, there seemed rather too many goods of the same class on view, though exposed by different firms, and it was observable that the section as a whole did not exert any fascination upon visitors, though from the students or reporters' point of view, the entire absence of that crowding which was so apparent in other sections of the building, came as a refreshing relief. In saying this, of course, we are fully alive to the possibility that our own observations as to the interest displayed by visitors, may not coincide with those of others who have had more extended opportunities of judging.

But to proceed to another point, an interesting, and withal, important exhibit in the French section was that designated as the Musée Centennal; here were to be seen samples of manufactured rubber of various dates, some of the vulcanized goods having been made in the fifties. The bulk of these exhibits were from the collection of M. Chapel, the author of the French work on India rubber and gutta-percha, and from what we could judge by a casual inspection, limited to sight only, it was abundantly clear that under favorable conditions vulcanized rubber of good quality is capable of lasting much longer than is usually supposed. An examination which is limited to sight, and in which the advantages of touch are excluded, is necessarily but of little value, and no doubt there have been others besides the writer, whose interest being more on the scientific than the commercial side of the manufacture, would have liked to have had somewhat closer communion with the samples exhibited than is possible where lock and key assert their supremacy. It must not be forgotten that rubber goods generally were made of better-class material 50 years ago than can be asserted of them to-day; the era of oil substitutes and of recovered rubber had not arisen as a necessary consequent of the loud cries for cheapness which became so prevalent at a later date. With regard to this craze for cheapness, it may be said in passing that the French manufacturers do not seem to be so much troubled by it as we are in England; for from what the manager of one of our leading works said recently, it seems that the French can make and sell various articles of pure vulcanized rubber, whereas there would be no sale for similar articles in England unless various well-known methods of cheapening the rubber were resorted to. "We are prepared to make quite as good articles as the French do in this particular line" said the manager referred to, "but there would be no sale for them in England, owing to the price being considered too high."

But to return to the museum of rubber we commend its inclusion, although regretting its limited usefulness to the casual visitor. Presuming that the history of the samples is known, they must be looked upon as possessing an intrinsic value in the way of enabling the manufacturer of to-day to form an idea of the probable longevity of his goods. Unless their history is accurately known, the value of the samples from a scientific standpoint is practically nil, for the particular conditions under which an India rubber article is used may form a factor with regard to its longevity more potent than the factors of chemical composition or efficiency of manufacture.

If we were asked what there is in the exhibits by other nations, which show a superiority over similar goods as manufactured in England, we feel constrained to point to caoutchouc durci, as the French call it, or vulcanite, to give it its English and German equivalent. The show of vulcanite goods in the French section is both large and comprehensive, and, indeed, the variety of uses to which this compound is put has excited the surprise of many whose knowledge of it is limited to one or two of its applications. Various articles for the chemical manufacture, such as acid pumps, tubes and buckets, are to be seen not in one or two exhibits, but in several, Italy, Russia, and Belgium, in addition to France, being noticeable for their display. The great vulcanite manufacturers of Germany are absent, and though it is painful to have to say anything derogatory about one's own country, it is doubtful if the few British manufacturers of this class of goods would have shown up well if they had been among the exhibitors. Somehow or other we seem to have fallen rather behindhand with regard to this branch, especially in the matter of the polish which can be applied to the surface of the goods. In this respect, one of the principal British firms recently owned that the Germans could beat us, and to judge by what is to be seen at the Paris Exhibition, this superiority is not a monopoly of the Fatherland. It may not be superfluous to say that there is a demand for vulcanite goods in the chemical manufacture in Germany and France, which is non-existent in England. These acid pumps, etc., are largely used by the manufactures of what are known as fine chemicals and medicinal products, a branch of manufacture which hardly exists in England, or, at least, not to anything like the extent to which it has attained in Germany, and it may be to an absence of demand that our defection in the manufacture is largely attributable.

The automobile tire is very prominent, both in the cases of the rubber manufacturers and in position on the vehicles shown in the Transport Section. As is well known, the automobile in its various forms has come into greater prominence in France than in England, though, whether or not this is due to the license in the matter of speed which is permitted in France, we do not care to say. One thing is certain, the very dangerous speed at which these vehicles gyrate through the crowded streets of Paris is a standing danger, and it is somewhat surprising that the authorities continue to allow it, all the more as several fatalities have already occurred. With regard to the manufacture of tires for these automobiles, English rubber manufacturers have been somewhat chary of going into the business; they prefer to bide their time and wait to see what the volume of business is likely to amount to in the immediate future before going to the expense in molds, which the manufacture would necessitate. Up to the present this Fabian policy has been justified, for it cannot be said that the automobile is making that progress in England which was confidently predicted a year or two ago by the enthusiastic supporters of this class of locomotive. Popular opinion seems to incline to the pneumatic rather than the solid tire, though there are several points regarding these tires, both physical and chemical, upon which opinion is yet divided, and those firms who go into the manufacture later on will have the advantage of profiting by the knowledge which has been gained by those first in the field.

The manufacture of rubber footwear, or galoshes, as we generally term them in England, is now being carried on to an increasing extent in countries other than the United States and Russia, where it has long formed the principal item in the rubber manufacture. The number of these rubber boots and shoes which are made and sold seems almost incredible to those of us who know the limited, though it must be said increasing, favor with which they are regarded in Great Britain. At the present time there are four or five firms making these goods in Great Britain, the most important being the North British Rubber Company, who are successfully competing with the American product in the Eastern markets, China, be it said, being a large purchaser. Though an American factory holds first place in point of production, the Russian-American Rubber Company of St. Petersburg comes a good second. With the American product we have

nothing to do in this notice, as the States do not exhibit; but with regard to the other countries whose products are on view, we feel constrained to award the most favorable notice to the Russians; for the goods both of the company just mentioned, and even more of the Russian-French Company, of Provodnik, near Riga, are shown in greater variety, and in themselves are of greater attractiveness than are those of the other countries exhibiting. The variously-colored plush and fur trimmings with which the Russian boots are adorned give a pleasing appearance to a sombre article; and although we do not ignore the fact that the climatic conditions in Russia are of greater severity than is the case with the majority of countries where these boots are sold; yet it is difficult to avoid feeling that manufacturers might benefit by taking a leaf out of Russia's book, by producing an article more pleasing to the eye than is the case at present. It is a safe assumption that the complaints as to ugliness, eminating from one sex perhaps more than the other, would thus be successfully combated, with the result of increased business.

With regard to gutta-percha, every article which is made from this useful body seems to be present in one or other of the show cases, a notable exception being the golf-ball, which, we are given to understand, is not being manufactured in France, though we can say nothing with certainty with regard to the rest of the Continent. As in the case of vulcanite, gutta-percha articles especially intended for use in chemical works are conspicuous, and it is evident that its use by the chemist is anything but restricted to dealings with hydrofluoric acid, as reference to the various textbooks on chemistry would lead one to imagine. Reference was recently made in these columns to the opinion which exists in many minds that India rubber and gutta percha are identical substances, and traces of this erroneous idea are to be observed in some of the catalogues and guides connected with the Exhibition. The slip in such cases is not of much moment, but we hope it has not occurred in the labeling of exhibits by presumably responsible persons, though we must say that the samples described as gutta percha from Liberia and from Peru aroused in our mind an uneasy feeling of suspicion that a mistake must have crept in somewhere. We may, of course, have no ground whatever for our feeling of mistrust, but all the same it makes us somewhat shy about indulging in any comments relative to new sources of supply of this important material.

It is noticeable that, although much has been heard of late, both in England and on the Continent, with regard to the production of substitutes for India rubber and gutta percha, any exhibits of such materials are wanting; and not only is this the case with products comparatively new to the world, but also with regard to old friends, such as the oxidized oil substitutes. It is, perhaps, not surprising that the rubber manufacturers, at any rate, should be somewhat bashful in proclaiming the existence of such bodies to the world; and notice is only taken of the fact because exhibits of these bodies have formed a prominent feature in other exhibitions. The expression "We do not use substitute" is, even in the present year of grace, still to be heard in England; but it does not always carry conviction to the listener if he be one conversant with the details of the rubber trade.

But not to pursue this dark subject further, it should be said that vulcanized fiber is on view in the American Section, and the Société Française de l'Ambroïne, of Rue du Bac Tury-Port, has a good show of their product, which seems to have established its claim to favor as an insulating material, and to be capable of replacing vulcanite in many of its applications. Its component parts are fossil resins, asbestos, and mica, in proportions varying according to the purpose for which the material is intended; and it will be seen at once that it is capable to a high degree of resisting heats, acids, and oxidizing agents.

THE RELATION OF STIMULUS TO SENSATION.

NOTHING has done more to place on a scientific footing the discussion of the phenomena which the study of matter and energy presents to the eye of reason, than the establishment of a doctrine of quantitative equivalence. So much oxygen and hydrogen, so much water; this amount of energy of chemical separation gone, that amount of sensible heat gained. In a similar way, nothing is likely to do more to give support to the hypothesis that sentience or consciousness is a concomitant of certain physiological processes than the establishment of a quantitative relation between stimulus and sensation.

It has, indeed, long been obvious that some general relation of this kind holds good. Increased physical pressure is, within certain limits, increasingly felt; more light gives a higher degree of visual sensation; the greater the amplitude of the vibration of a violin-string the fuller and louder the sound. Such statements are, however, indefinite. We want to know how much the physical increase must be to give just so much increment in sensation. If we double the strength of the stimulus, do we double also the strength of the sensation? If not, by how much do we increase it? Ernst Heinrich Weber sought to express the quantitative relation with some exactness; Gustav Theodor Fechner and other more recent inquirers have built upon the foundations laid by Weber; and a provisional law of the relation of physical stimulus to felt sensation has gradually gained wide acceptance.

Weber's classical experiments dealt with what is termed the "least observable difference." If, for example, a weight of one pound be laid upon the hand, it gives rise to a sensation of pressure. If, now, an extra ounce be added, no difference is felt, nor is the added weight of two or of three ounces perceptible. The sensation is not increased, and then only just perceivably increased, till one-third of a pound is added. This, then, is said to be the least observable difference. We now start afresh with a load of two pounds, and add, as before, one-third of a pound. But there is no observable difference; nor is there any felt increase in sensation until two-thirds of a pound are added. Starting once more with an initial load of three pounds, we find that neither the addition of one-third, nor that of two-thirds of a pound affords any observable difference in the sensation experienced. A full pound must be added for the increment to be felt. The least observable difference, therefore, are between.

1 pound and $1 + \frac{1}{3}$ pounds.
2 pounds " $2 + \frac{2}{3}$ pounds.
3 pounds " $3 + 1$ pounds.

If, then, we extend and generalize the results of such experiments, we find that, within certain limits, to obtain an orderly series of just observable differences in sensation we must always add the same fraction—one-third of the weight—at each constant step of the series.

Now Fechner assumed that these just perceivable increments of sensation are all of the same value, or are constant; in which case they form an arithmetical series—that is to say, one that is produced by successive additions of the same amount. But the corresponding series of stimuli are not in arithmetical progression, since the successive increments are not of the same amount. The increase is, however, always by the same proportional amount. Each successive stimulus has to be multiplied by a constant factor, $\frac{4}{3}$. The series, therefore, forms an orderly sequence in geometrical progression.

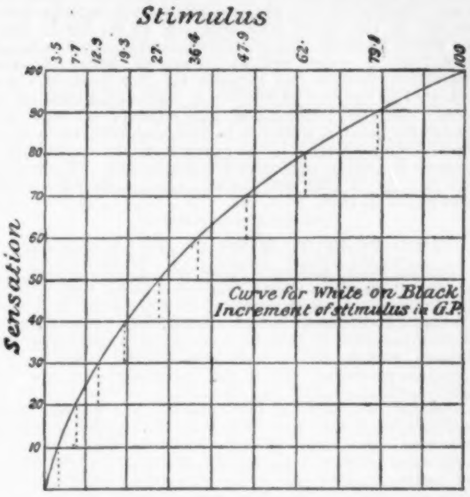
We thus reach what is known as the Weber-Fechner formula, by which the relation of stimulus to sensation is expressed in quantitive terms. It may be thus stated: To obtain an arithmetical series of sensations a geometrical series of stimuli is required. To give the former, equal increments of sensation are added; to obtain the latter we must multiply the successive stimuli by a constant factor.

It must be admitted, however, that the result of a great number of carefully-conducted observations are by no means in satisfactory accordance with this formula. Hering and his pupils have shown that for very small stimuli lying near the threshold of sensation, both stimulus and sensation increase very nearly pari passu in arithmetical progression. The Weber-Fechner formula cannot, therefore, at present be regarded as more than an approximation to the truth.

In extracting the Weber-Fechner formula from the data afforded by observations on the method of least observable difference, it is necessary to piece together the results observed singly and in succession. But from the nature of the field of vision it is possible to obtain a series of increments of stimulus which shall afford a scale of sensation visible as a whole and at a glance. In the current number of The Psychological Review (vol. vii., No. 3, p. 217) I have published in detail the results of an investigation. "On the relation of stimulus to sensation in visual impression," by which I have been led to suggest a modification of the Weber-Fechner formula. Stripped as far as possible of technicalities, the method and results may be here briefly described.

It is well known that if a disc with white and black sectors be rapidly rotated, the effect on the eye is a uniform gray. If the white sectors are proportionally small, occupying, for example, only 5 per cent. of the disc, the effect is that of a very dark gray; if they are relatively large, occupying, say, 90 per cent. of the disc, the effect is that of a very light gray. With such sectors the same proportional amount of white is introduced in all parts of the disc, so as to give in each case the same shade of gray throughout its whole extent. But it is possible to introduce varying proportions of white from center to circumference, and when this is done the rotating disc no longer presents all over its surface the same uniform shade of gray, but shows varying shades. Let us now endeavor to reduce these varying shades to order. Let us arrange the proportions of white stimulus which we introduce, in such a way as to leave a ring of full black (with no white) at the circumference, and to give a ring of full white (with no black) near the center, and between these extremes to obtain a perfectly smooth and even gradation of shades of gray from one so dark as to be scarcely distinguishable from black, to one so light as to be scarcely distinguishable from white. We may, then, when the disc is rapidly rotating, run our eye from white near the center, through deepening and deepening gray, to black at the circumference, with nowhere any observable jump in sensation—nowhere, so to speak, a steeper slope of change than elsewhere, as if, in fact, we were passing along a perfectly even inclined plane of sensation from the lowest depth of black to the extreme height of white. If we succeed in this—and it is by no means easy of attainment—we shall have secured an arithmetical series of sensation. From one end to the other we have at successively equal distances constant increments of white sensation, just as in ascending a uniform incline we gain equal increments of height for every yard we progress toward our goal. This even slope of sensation is produced by the juxtaposition of all the least observable differences whose sum gives the full scale. Having obtained this result we are able to ascertain, by careful angular measurements of the proportional areas of white at different parts of our disc, the exact amounts of stimulus which are effecting the eye from these several parts. We may, for example, subdivide the area of the disc lying between the inner white circle and the outer ring of black, by drawing nine concentric circles equidistant from each other, and at these nine distances make angular measurements of the proportional amounts of white to black; and then by, plotting, sweep a curve of stimulus through points representing these measured amounts.

When these amounts are tabulated and dealt with by appropriate mathematical methods, it is found that they are not in accordance with the Weber-Fechner formula. Nor does a disc prepared in accordance with this formula give the smooth and evenly-graded incline of an arithmetical series in sensation. For details the reader may be referred to the paper in which the observations and calculations are set forth. The accompanying figure gives the results plotted in a curve on the graphic method. The dotted steps indicate the nine measured increments. The vertical distance of any point on the curve, measured from below, upward, gives the percentage of sensation. The horizontal distance, measured from left to right, gives the corresponding percentage of white stimulus. The law which results from a discussion of these observations, and of others where red, orange and blue stimuli were used instead of white (each of which gives a different curve on the same principle), may be thus formulated: For constant increments of sensation the concomitant increments of stimulus are in geometrical progression. This differs from the Weber-Fechner formula in



assigning the geometrical progression to the successive increments of stimulus.

The subjoined table gives the increments and sums of stimulus and sensation at ten stages between black and white. A comparison of the last two columns will show the extent of agreement between observation and calculation. The numbers given under the head of stimulus are calculated on the basis of the suggested law, the number 27 per cent. of stimulus, as the concomitant of 50 per cent. of sensation, being taken over from observation as a basis for calculation.

White on Black.

Stage	Sensation		Stimulus		Observed percentage of stimulus
	Increments	Sums	Increments	Sums	
10	10	100	20·90	100	100
9	10	90	17·13	79·10	79
8	10	80	14·03	61·97	62
7	10	70	11·51	47·94	48
6	10	60	9·43	36·43	35·8
5	10	50	7·73	27	27
4	10	40	6·33	19·27	19·5
3	10	30	5·20	12·94	13
2	10	20	4·25	7·74	7·9
1	10	10	3·49	3·49	3·5
0	0	0	0	0	0

Although I venture to hope that the results of this investigation contribute something toward a solution of the problem, still it will be seen that we have as yet by no means reached the stage at which we can claim that a law expressing the quantitative relation of stimulus to sensation is established beyond question. But from the work of many observers we may, at least, draw the conclusion that there is some well-defined relation, though its law at present eludes the grasp of our generalization. And this so far lends support to the doctrine of concomitance.

There has been much discussion as to the true meaning of the relation. It is primarily a relation between physical stimulus and physiological response, or between physiological response and psychological concomitant. In other words, is the law we seek primarily a physiological or a psychological law? We cannot enter upon the discussion here. Attention may, however, be drawn to two facts:—First, that Prof. Pfeffer claims to have shown that the attractive influence of malic acid on the spermatozoids of ferns is approximately in accordance with the Weber-Fechner formula; and secondly, that Dr. Augustus Waller's researches on the excitation of muscle and nerve indicate some such relation, though not exactly this relation, between stimulus and physiological response. In view of these facts, it seems not improbable, therefore, that the relation may prove to be primarily physiological; in which case we may infer that sensation is directly proportional to the molecular disturbance in the nerve-centers concerned.—C. LLOYD MORGAN, in Nature.

COMMERCE WITH PORTO RICO.

COMMERCE between the United States and Porto Rico during the two months in which the new tariff act has been in operation shows an enormous increase over that of the corresponding two months of the preceding year. This is the more observable because of the assertion which has been frequently made during the past few months that the island is practically impoverished since the storm of last August. Notwithstanding the conditions due to the storm, both as to material for exportation and facilities for purchase, the exports to the United States in May and June, 1900, were 50 per cent. in excess of those of the corresponding months of 1899, and the imports from the United States were more than double those of the same months in 1899. In May and June, 1899, the imports into the United States from Porto Rico, as shown by the reports of the Treasury Bureau of Statistics, were $1,461,998, and in May and June, 1900, they were $2,322,124. In May and June, 1899, the exports to Porto Rico from the United States were $666,987, and in May and June, 1900, they were $1,587,478. Thus the imports into the United States from Porto Rico show in May and June, 1900, an increase of 60 per cent. over those of the same months of 1899, both of which occurred prior to the storm of that year, and the exports from the United States to Porto Rico show an

increase of 140 per cent. over the corresponding months of 1899.

The figures of the total commerce with Cuba, Porto Rico, Hawaii and the Philippines show in each case a marked growth, especially in exports. To Cuba, the total exports of the year are $26,513,613, against $18,616,377 in the fiscal year 1899, and $9,561,656 in 1898. To Porto Rico the exports in 1900 are $4,640,435, against $2,685,848 in 1899, and $1,505,946 in 1898. To the Hawaiian Islands the exports for the year 1900 are $13,509,148, against $9,305,470 in 1899 and $5,907,155 in 1898. To the Philippines the exports of 1900 are $2,640,449, against $404,193 in 1899 and $127,804 in 1898. To the Samoan Islands the exports of 1900 are $146,267, against $56,532 in 1899 and $39,982 in 1898. To Guam, the exports of 1900 are $13,247, against $6,883 in 1899 and $4,070 in 1898.

THE FRENCH MISSION TO YUNNAN.

THREE weeks ago only those who closely follow the course of events in China knew the name and rôle of M. François, Consul General of France in Yunnan. To-day M. François is celebrated. He is in danger. With a handful of French troops he is guarding the French flag in the center of a distant and hostile Chinese province. Upon his coolness depends his safety and that of his companions.

During the course of the mission that he has been fulfilling since the end of the year 1898 in the southern provinces of China, M. François has taken a large number of photographs, reproductions of some of which we herewith place before the eyes of our readers, along with a brief narrative of his voyage.

M. François started from Paris in October, 1898, and stopped a few weeks at Hong Kong and Canton to

GEN. KOUEI-SONG-TSONG-PING,

COMMANDER OF THE TROOPS OF LIEOU-TCHEOU-FOU.

await the arrival of his interpreter and organize the means of transportation.

The junk upon which he was to ascend the river Si Kiang was 95 feet in length, 13 in breadth, and of 4 feet draught. Besides the baggage of the Europeans, it carried thirty tons of merchandise.

M. François began his journey at the end of December, 1898. The junk was towed up to the terminal point of steam navigation by a steam launch put at his disposal by the viceroy. He thus reached Vou-tcheu-fou, an important commercial center, after four days of navigation. After a short stay at this place, he started for Tsiun-tcheau-fou, at the confluence of the two great branches of the river Si-Kiang. One of the branches of this great river of Southern China flows along the frontier of Tonkin in passing through Nan-wing-fou. This is the western branch. The other branch starts from Yunnan and flows through the center of the province of Kouang-Si. This is the northern or Pei-Kiang branch. In his preceding voyages, M. François had thoroughly explored the western branch, and had orders now to do the same with the northern branch and its affluents.

The first obstacle in the way of the entrance of junks into the Pei-Kiang is a sand bar formed by the violent currents. Here, too, begin rapids that the travelers were afterward to meet with continuously.

The country of the Kouang-Si traversed by the river is arid and rocky, and almost everywhere offers the spectacle of desolation.

The thinly scattered population belongs to a race which is not very well defined, which the Chinese call Tchouang, and which according to them came from Hou-Pei. The Tchouangs are essentially agriculturists, who live in groups of a few families upon the arable land of the region.

Markets are rare and the difficulty of procuring food is great. Tchouangs raise a few cattle, but the animals are not designed for slaughter, and the only meat found in the market is that of animals that have died a natural death.

A person may travel through this country for several days without meeting with an inhabited center. The river flows between compact masses of rocks, through a desert and unproductive region. Game itself is extremely rare, and the absence of birds of prey shows that the country nourishes nothing.

M. François, in March, finally reached Lieou-tcheau-fou, indicated as a great commercial center. The town stretches out above banks that are themselves covered with temporary structures that disappear at every freshet. In the interior of the town there are about three streets, one of which skirts the southern face, and the central part of which is occupied by a few stores stocked with articles from Canton. Another transverse street, in which no business is done, joins the street of the north gate, which allows of exit to the country. In the intervals, groups of houses arranged without order give rise to alleys that intersect each other in every direction, and which are genuine sewers. The rest, or, more accurately speaking, the whole is nothing but a fearful cesspool.

In the midst of all thess horrors are constructed the "Yamen" of the mandarins. Externally, and to the east there are a few handsome pagodas.

The navigation of large river boats ends at Lieou-tcheou-fou, and M. François was, therefore, obliged to abandon his junk and take one of the native "sampans," a sort of long pointed piròque covered with mats. In a few days he reached Lieou-tchen-Hien, at the junction of the Lieou-Kang and Long-Kiang. M. François here entered the latter river, which extends to King-Yuan-fou, the starting point of the land route, which he reached after twelve days of most troublesome navigation.

King-Yuan-fou is a prefecture, but we find here again the poverty and general air of dilapidation that characterizes the other towns of the Kouang-Si. The country produces absolutely nothing, and commerce is non-existent. Wood even is wanting in this region covered with rocky and denuded mountains. What is consumed is derived exclusively from the territories that have not as yet been invaded by the celestials, for with the Chinese comes absolute devastation.

UPON THE GRAND ROUTE OF KOUEI-TCHEOU, NEAR TOU-YUN-FOU.

Two principal routes end at King-Yuan-fou, one of which runs to the south toward Nan-Ning-fou and Pak-hoi, and the other to the west toward Kouei-Tcheou.

The coolies that do the carrying upon these roads are recruited by special agencies. The wages (paid in advance) per man and per day are about twenty-five cents. The carrier must be accompanied by overseers furnished by the same agencies at the same price. The mean weight of the load is from 85 to 90 pounds divided into two packages carried at the extremities of a bamboo. The daily journey varies according to the road, and may reach from 12 to 15 miles.

The road, which is pompously called the "great route" and upon which M. François was to advance, does not exceed 30 inches in width. After a troublesome journey over it, our explorer and his party reached Houai-Yuan-Tchen, a large town of from 2,500 to 3,000 inhabitants, established in the acute angle of the two rivers. Here a market is held, and a few shops are to be seen along the sole street that borders the route.

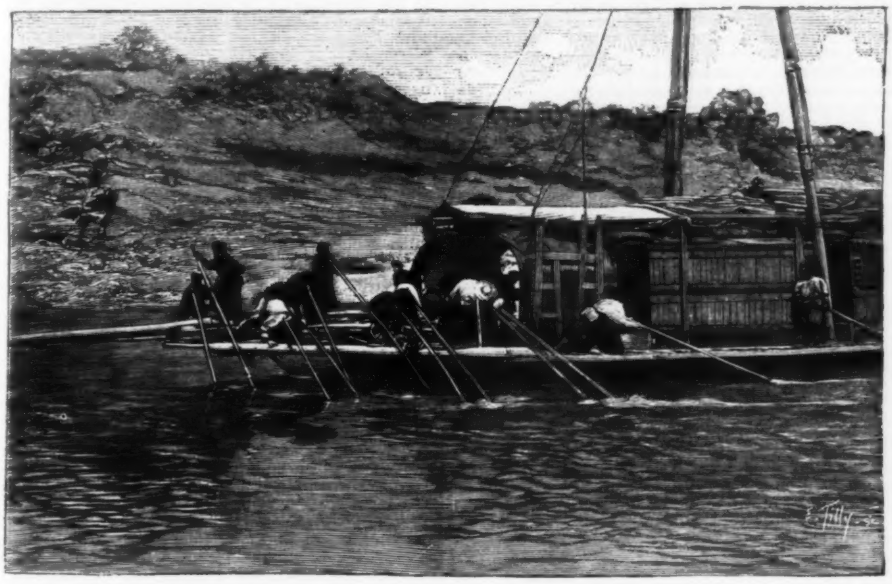
M. François afterward advanced through a broken country in following a tortuous line, and in climbing and descending steep hills, and finally reached To-

THE CROWD AT THE ARRIVAL OF THE EUROPEANS AT LIEOU-TCHEOU-FOU.

Cheng-Tcheng, and afterward the sub-prefecture of Li-Po-Hien, in the vicinity of which the frontier of Kouei-Tcheou is crossed.

The frontier of Kouei-Tcheou marks a complete transformation in the temperature, in the aspect of the country and in the vegetation.

After some more difficult traveling, M. François reached the basin of the Yang-tse-Kiang, the first affluent of which was traversed in front of Tou-Yun-



COOLIES POLING A JUNK IN A RAPID.

NATIVE SOLDIERS OF YUNNAN ARMED WITH THE GRAS GUN.

M. FRANÇOIS WRITING UP HIS JOURNAL DURING A HALT.

fou. This city, which is some seven miles in length, is in the vicinity of three watercourses, but its filthiness is still more abominable than that of the cities of the south.

At this point is remarked a change in the direction of the commercial current, and carriers are met with coming from the Yang-tse-Kiang. For the sea salt sent from Canton are substituted blocks of gray salt from Tse-Tchouan. But the country is still very destitute and opium is always the principal element of traffic.

Tou-Yun-fou, which is the seat of a prefecture, is without much interest, and has but little commerce. Its altitude is not more than 2,000 feet, but the route afterward rapidly ascends to 3,900 feet at the pass of Tong-chan-Ping. The declivities are still more wooded upon this part of the route and are covered with chestnuts, poplars and acacias. The woods are frequented by deer, tigers and panthers, and the very sparse population belongs to the Miao tribes.

The direction changes again to the southwest, and the region through which the road passes becomes more and more arid until the citadel of Kouei-Yang is reached. Upon the whole, upon this route, intersected by so many hills, the obstacles are all superficial, and the surface might be compared to a huge chestnut burr, the prickles of which render all penetration impossible.

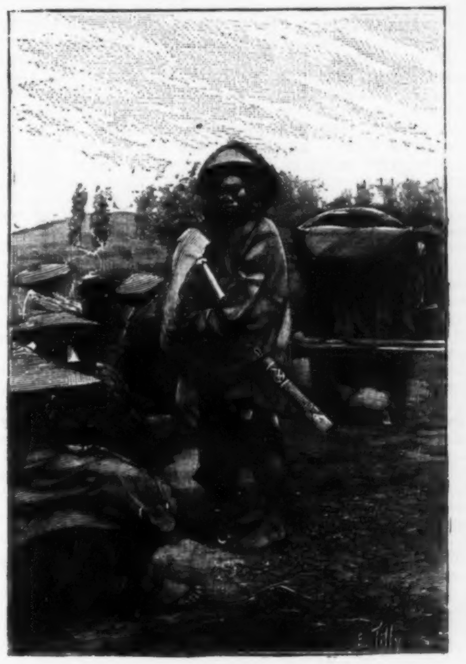
From Kouei-Yang, where he remained several months, M. François proceeded toward Yunnan. He was, unfortunately, accompanied with a persistent rain, which greatly increased the difficulty of the traveling of the convoys. The eastern Yunnan that he traversed appeared to him to be as poverty-stricken and destitute of commerce and resources as the regions of Kouei-Tcheou and Kouang-Si, with a population sparse, poor, and depressed by disease.

At his entrance into Yunnan, M. François remarked a change of attitude among the authorities, who positively refused to receive him. By force of energy and ability, however, he succeeded in causing himself to be recognized by the viceroy and obtaining from him the lodging due, in a Chinese country, by the authorities, to travelers provided with an official recommendation.—For the above particulars and the engravings we are indebted to L'Illustration.

THE EXPEDITION TO LAKE TANGANYIKA.

UPWARDS of eighteen months ago a committee was formed for the purpose of promoting the further exploration of Lake Tanganyika and of the other lakes to the northward in the great Central African depression. Prof. Ray Lankester, F.R.S., acted as chairman of the committee, the other members being Sir John Kirk, G. C. M. G., Sir W. Thiselton-Dyer, K.C.M.G., Mr. P. L. Sclater, F.R.S., and Mr. G. A. Boulanger, F.R.S. A sum of £5,000 was required for the work, and of this amount the Royal Geographical Society promised £600, Mr. Alfred Beit gave £1,000, and two other gentlemen, who did not desire to disclose their names, contributed £500; Mr. Berridge, who was himself one of the members of the expedition, contributed £1,500, and the balance was made up by smaller donations.

The leadership of the expedition was intrusted to Mr. J. E. S. Moore, whose investigations of the fauna of Lake Tanganyika had suggested the desirability of further investigation to the committee. The other members of the expedition were Mr. Berridge, Mr. Arnold Matthews, and Mr. Malcolm Fergusson, who was in charge of the surveying and cartographical



A SOLDIER OF THE ESCORT.

work. The members of the expedition left London on April 19 last year, and after an absence of less than fifteen months, have just returned to London, having successfully accomplished the objects they had in view. The main object of the expedition was to make a complete biological investigation of Lake Tanganyika, but it was intended also to examinine the geological structure of the mountain ranges on both sides of the lake, and to carry the investigation northward up the Rusisi Valley to Lake Kivu and on to Lakes Albert Edward and Albert. After a short stay at Zanzibar the expedition proceeded at the Chinde mouth of the Zambesi and arrived at Blantyre in the British Central Africa Protectorate on June 28. The southern end of Lake Nyasa was reached a fortnight later, and more than a month was spent in taking soundings and other observations on that lake. All previous attempts to discover the maximum depth of the lake had failed owing to the insufficient length of the sounding lines; but Mr. Moore's expedition was fully equipped with the necessary appliances, and as the result of his investigations he succeeded in establishing that the greatest depth of Lake Nyasa was 430 fathoms.

By arrangement with Sir David Gill, the Astronomer Royal of Cape Town, the time was wired over Mr. Rhodes' Trans-Continental telegraph wire to Mr. Furgusson at Blantyre, who was also able, from bearings taken by the Anglo-German Boundary Commission, to find the error of his watches at Nkata Bay on Lake Nyasa, and subsequently at Kituta on Lake Tanganyika. After crossing the Nyasa-Tanganyika Plateau the expedition arrived at the southern end of Lake Tanganyika on September 20, and a week later proceeded up the lake. Mr. Furgusson took the bearings of the various places at which they called on either side by astronomical observations, with the result that it was discovered that the real position of the northern half of the lake was, roughly speaking, some twenty miles further to the west than it appears on existing maps. Its main outline was found to be fairly accurately represented. While traveling on the lake Mr. Moore succeeded in making a very large collection of fishes, some of them of great size, and some

new to science. The general result of his observations was to throw doubt on the suggestion that the lake had at one time been connected with the sea, but the geological formation on the west shore favors the supposition that at one time the lake extended far to the westward, and covered some portion of what is now the Congo Basin. Careful examination was made of the mouth of the Lukuga outlet of Tanganyika. The mountains, which all along the western shore of the lake are very high, slope down gradually from Tempwi on the south, and from Mtowa on the north toward the Lukuga Valley. The character of the Lukuga at its junction with the lake makes it difficult to believe that it can ever at any time have been blocked by vegetation.

After completing their investigation of the lake the expedition left Usambura, the German station at its northern extremity, some time in November, and, following the Rusisi Valley, along the route over which Mr. Grogan had shortly before passed, arrived at Lake Kivu. In the mountainous region to the north of Lake Kivu two volcanoes were discovered in a state of activity. The relations between the Germans and the officials of the Congo Free State in this region were somewhat strained. A German station had been established considerably to the west of Lake Kivu, and the Belgians in their turn had founded a station to the east of the German station. A sort of armed neutrality was maintained, and it is satisfactory to know that the question of the boundary between the German and the Belgian spheres of influence in this part of Africa is engaging the serious attention of the two governments in Europe. The result of the observations taken by Mr. Fergusson is to place the Rusisi River and Lake Kivu some considerable distance to the west of the positions they now occupy on the maps. Mr. Moore is inclined to agree with Mr. Grogan as to the non-existence of Mount Mfumbirno, a mountain which has figured at various times within the British, German, and Belgian spheres of influence.

On quitting the Kivu region, Mr. Moore passed up the west side of the Albert Edward Nyanza. It will be remembered that Mr. Grogan followed the eastern shore of that lake. After crossing the Semilki River, Mr. Moore devoted some time to the investigation of Mount Ruwenzori. He came to the conclusion that Ruwenzori is neither an isolated mountain mass nor a plateau, but a mountain range with many jagged peaks extending from the northern end of the Albert Edward Nyanza to the southern end of the Albert Nyanza, and thence following, in a north-easterly direction, the eastern shore of the latter lake. Mr. Moore succeeded in ascending what he belives to be the highest peak of the range at a height of 16,500 feet. The snow-line is at a height of about 13,000 feet, and Mr. Moore determined the existence of numerous glaciers. The sides of the mountains are covered with forests of giant groundsel and of bamboo. Close to the summit Mr. Moore found some mosses, and he also succeeded in obtaining a considerable number of interesting geological specimens. After adding to his collection of fishes from the Albert Nyanza, Mr. Moore went to Uganda, and from there reached the coast at Mombasa, traveling for the latter part of the journey along the new Uganda Railway.

The collections formed during the course of the expedition are of great scientific interest. The main object of the expedition was to investigate the fauna of Tanganyika and the smaller lakes to the north. Mr. Moore has brought back with him in excellent condition about a thousand fishes, the examination of which cannot fail to throw much new light on the biological problems of the great Central Africa depression. Mr. Moore's collection of geological specimens is also of extreme interest, and the surface features of the country are illustrated by a very large collection of photographs. Mr. Malcolm Fergusson's astronomical observations, fixing the positions of a large number of places along the route followed by the expedition, will be of the utmost value in enabling cartographers to reconstruct the map of Central Africa. It was anticipated that at least eighteen months would be required for the work, and Mr. Moore was prepared, if necessary, to be absent from England for two years. Fortunately, the improved facilities for traveling in the heart of Africa have made it possible for him to return to England in less than fifteen months after his departure; but the return of the expedition earlier than was anticipated does not in any way imply that any portion of the plan originally sketched out has been abandoned.—The Times.

A New Photographic Restrainer.—A contributor to The Chemist and Druggist writes: "Potassium borotartrate has been suggested as a restrainer in place of bromide. Mr. B. E. Edwards, who makes the suggestion, claims that whereas bromide of potassium retards development, and so alters the sale of graduation, giving greater density in the high lights, and cutting out detail in the shadows, potassium boro-tartrate restrains in the opposite direction. It holds back the density without interfering with the detail, and renders weakening of the developer unnecessary. Potassium borotartrate is familiar to chemists under the name of soluble cream of tartar. It is made by heating together cream of tartar and boric acid with water, and evaporating to dryness. Soluble cream of tartar has been used in medicine, but is better known to pharmacists as a pill-excipient. In photography it is recommended to be made into a 10 per cent. solution, of which 10 to 30 minims is to be added to each ounce of mixed developer. As a restrainer potassium boro tartrate works best with pyrogallol or kachin."

Paper from Turf.—Consul Mahin, of Reichenberg, under date of July 7, 1900, says:

According to the business columns of a Reichenberg newspaper, an Australian manufacturer, in his search for a cheap raw material for papermaking, has successfully experimented with turf. It is alleged that from the cleaned and bleached turf fibers he produces a remarkably durable paper substance. This method is said to have been patented in various civilized countries and to be meeting with gratifying success. Paper of various kinds, pasteboard, and paper boxes are now made out of turf, and are declared to be of good quality and to have great power of resistance.

TRADE NOTES AND RECEIPTS.

Development and Fixing of Bromide Plates by a Single Solution.—(From the French of M. P. Hannecke in the Bulletin de l'Association Belge de Photographie).

It is an old rule that developing substances ought to be kept strictly separated from the fixing bath, the latter otherwise causing fog, and sometimes even destroying the image completely. On the other hand, it is a well-known fact that certain developers, as metol and orthol, allow of adding a small quantity of hyposulphite, which then imparts more clearness to the negative. I have tried to add a larger amount to orthol, but without success; and my experiments with other developers have not been more fortunate. There is a single exception; it is pyrocatechin.

To make trials of chemical development with a single developing and fixing solution, it is important, above all, that the developer shall be so composed as to be able to develop the image rapidly and clearly. The reducing action ought not to be interfered with by the large quantity of hyposulphite absolutely essential for the complete fixing of the image. For the combined operation very energetic developers are needful, particularly those that contain caustic alkalis. However, it has been proved that with different developers containing caustic potash, the action of the fixer precedes that of the developer. Only, pyrocatechin is an exception. When the quantity of the fixer is reduced, so as to allow the better action of the developer, the fixing of the negative is not completely finished. All the formulas containing caustic alkalis have the defect of being the cause of "frilling" and of detaching the pellicle from the glass. The large quantity of caustic potash contained in the solution is precisely the cause of "frilling."

E. Vogel has found that with pyrocatechin as a rapid developer, a surplus of caustic potash is not requisite, and that it is sufficient to employ the exact quantity needful for the formation of the dicaustic salt; that the quantity of caustic potash can even be still further reduced, while yet obtaining an extremely rapid developer.

I recommend the following composition for a concentrated developer of pyrocatechin, which for general use ought to be diluted with water:

A	Pyrocatechin	7 grammes.
	Caustic potash	7 "
	Crystallized sodium sulphite	30 "
	Water	75 cc.

This form of developer has given excellent results in fixing and developing bromide plates by a single solution. Nevertheless, it must not be forgotten that plates of different brands are differently composed, and that some are fixed very slowly.

For this reason, a single and combined bath does not answer for all plates

It is to be remarked that the time of exposure does not differ from that necessitated by the process of separate development and fixing. The combined solution may be employed at least twice. The rapid action is readily explained by the presence of an extremely energetic developer and a fresh and very strong fixing salt.

This developer may also be employed for chlorobromide diapositives and for bromide papers.

Experiments with Hair Dyes.—Broer reports on his experiments with various harmless hair dyes.

The application of sodium sulphide and bismuth subnitrate imparts an ugly gray color to the hair.

Potassium permanganate in an aqueous solution (1 per cent.) dyes the hair a brownish-blonde of comparative strength.

Extract of walnut shells or of walnut leaves in a 5 to 10 per cent. aqueous solution is without any success, nor can India ink be employed. By washing with water the hair loses the acquired shade again.

Very efficacious, however, is hanna, i. e., the leaves of Lawsonia inermis. The powder of these leaves is made with water into a paste which is rubbed into the hair by means of a brush and later on is washed out again. The longer the hanna acts on the hair, the darker the color will become, which varies from pale brown to orange-red. After an action of 45 minutes the hair is dyed light brown; after 4 hours, reddish-brown to golden blonde, a shade very popular among the ladies, after 24 hours orange-red and unnatural.

Hanna is very suitable for the application because the degree of the color can be determined by the length of time used for the dyeing.—Monatshift für praktische Dermatologie.

Cantharides Pomade.—

Beef marrow	900 grammes.
White wax	100 "
Mace oil	3 "
Clove oil	3 "
Tincture of cantharides	28 "
Geranium oil	30 drops.

Melt the fats in the water bath and add the volatile oils and, finally, the tincture of cantharides.

Quinine Pomade.—

Beef marrow	325 grammes.
Prepared lard	225 "
Almond oil	55 "
Peru balsam	3 "
Quinine sulphate	3 "
Clove oil	7 "
Rose oil	30 drops.

Melt the first three substances together in the water bath, then add the Peru balsam and the quinine sulphate. Perfume and let cool.—Journal de la Parfumerie et Savonnerie Française.

As a remedy for facial perspiration, Monin recommends:

Lavender water	50 grammes.
Lemon water	50 "
Peppermint water	50 "
Tincture of myrrh	50 "
Tincture of guillaya	50 "
Sodium carbonate	20 "

Application:—Three times daily moisten a portion of a napkin dipped in water and wrung out, with the above mixture from a dropping bottle, and wash the face with it.—Therapie der Gegenwart.

SELECTED FORMULÆ.

Metal Polishes, Pastes, Liquids, Powders, Soaps, etc.—At one time we had to get along with only a few makes of metal pastes; these were nearly always red in color, the exceptions being black, says Oils, Colours and Drysalteries. (W. Dr.) But things have now altered. During the past few years more than a score of new brands have appeared, and considering the liberal house-to-house sampling of the rival makes that goes on, it is a wonder that housekeepers require to buy any at all. In one neighborhood we remember four sampling teams going around in one week. However, the paste was not wasted, but put to other useful purposes. It made a good boot dubbin; someone found it a fair cycle chain lubricant; another genius used it as a substitute for grease paint in private theatricals; while, perhaps, the best thing of all was its employment as a window glass cleaner and polisher.

The manufacturer should take note of this little hint, as it answers well for the purpose, giving a mirror-like appearance and effectually prevents steaming. The tins should in future bear a few words in relation to this. It is not so dirty as when using water, the paste being simply rubbed on with one rag and polished with a clean one, with the application of plenty of elbow grease to remove smears. If a family now use one tin a week, using it for windows would increase this to at least two tins, and is tantamount to making two blades of grass grow where one did previously. This presents an opportunity to double even the existing large output without much trouble. Some of the best makes of metal polishes answer well for giving a keen edge to razors, a small quantity being applied to a leather strop. This is especially so when using a paste containing oxalic acid, as this has much affinity for steel, thereby producing the keen edge.

Once we used to wonder how it was that the ordinary German red putz pomade that floods the market came to have so many "sole agents," and yet always bore the same trade mark on the tins. Our curiosity was at last set at rest by learning that this kind of paste may be had in barrels from the works, which entitles the buyer to use the mark. The tins, also of German origin, are supplied with blanks for the insertion of the "sole agent's name." All there was to do, then, was to run down the paste and fill the tins. This is generally done by filling a kettle-like pot with paste and melting over a moderate fire. While this is going on the girl is busily engaged at the bench in laying out and removing lids from, say, a gross of tins. By now the contents of the kettle are liquefied, and the tins are filled; while cooling, the kettle is refilled and replaced on the fire. Then the girl quickly fixes on the lids and lays out another lot of tins, another girl packing the full tins in the wood or cardboard boxes. So the process goes on.

RED POLISHING PASTE (WITHOUT ACID).

A. C. peroxide (sesquioxide of iron)	40 pounds.
Venetian red (dry)	36 "
Palm oil	20 "
Petroleum jelly	20 "
Mineral lubricating oil	½ gallon.
Mirbane oil	4 ounces.

Melt the palm oil, mineral oil, and jelly; stir in the peroxide and red, add scent, then grind. Some pastes are not ground but simply mixed together, causing them to sweat when tinned; moreover, they do not look so well as those put through the mill.

The next mixture contains acid and makes a German style of paste. The color is red or chocolate:

RED POLISHING PASTE (ACID).

Rotten stone	30 pounds.
Bathbrick powder	28 "
Red ochre	26 "
Emery flour	14 "
Crocus martis	14 "
Oxalic acid	10½ "
Petroleum jelly	50 "
Mineral oil	1¼ gallons.
Citronella oil	6 ounces.

Powder the oxalic acid and mix with the earthy matters by running through sieves, then grind up with the greases. Some bases absorb more oil than others, and if the paste is rather stiff add more oil or jelly. The correct consistence for metal paste should be that of butter in winter. If softer, it will ooze out during the hot weather, but will not become so soft as butter does, as the earthy matters keep in the grease to a large extent.

Another paste is one of a

BUFF COLOR.

Petroleum jelly	42 pounds.
Refined paraffin wax	14 "
Powdered bathbrick	14 "
Powdered pipeclay	14 "
Powdered pumice	2 "
Yellow ochre	2 "
Oleic acid	1 "
Oil cassia	3 ounces.

Melt the wax and jelly, stir in the others, and grind as before.

Another polisher is known as

JEWELER'S POLISHING BAR.

Refined town tallow	80 pounds.
Sesquioxide iron	16 "
Oxalic acid	1 "

Powder the acid, mix with sesquioxide, and mould with the tallow into bars like soap. The sesquioxide must be quite free from grit, or it may scratch valuable work. It may be prepared by calcining equal amounts of oxalic acid and iron sulphate in a crucible for about fifteen minutes with a good draught.

The next is a

WHITE POLISHING PASTE.

Town tallow	36 pounds.
White mineral jelly	20 "
Non-gritty chalk	30 "
Levigated flint	4 "
Powdered pumice	3 "
Oxalic acid	2½ "

Melt the tallow and jelly, powder the acid, mix well with the pumice, flint, and chalk, mix all and grind.

(To be continued)

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Street Cars in Glasgow.—The street-car system of Glasgow is owned and operated by the city under the direct supervision of a committee of the town council. The report for the year ending May 31, 1900, shows that the total length of double track operated by the city is 41 miles 1 furlong 178 yards, over 42 miles 2 furlongs 161 yards of streets, making a total length of single track of 83 miles 3 furlongs 119 yards.

The gross capital expenditures for the system since 1894 (independent of operating expenses) have been $5,164,975, and the present indebtedness is $4,061,806. The capital invested is $4,559,502. Of the 41 miles of double track, 5 miles have electric traction, the rest being operated by horses. The total receipts of the system during the year were $2,286,850. The working expenses were $1,676,412, leaving a balance of $610,438, of which there was expended some $84,000 for interest on capital, $57,501 for sinking fund, $156,096 for depreciation written off capital, etc.

One item of $60,000 consists of payments made to the general revenue fund of the city, which is in lieu of the amount which the city would receive in taxes, it is presumed, were the system operated by a private company. The balance goes into the reserve fund.

There are 3,400 persons employed, including 100 clerks. The general manager receives $6,800; the chief engineer, $2,400; the electrical engineer, $2,000; and the mechanical engineer, who has charge of the power station, $1,216. Point boys receive 28 cents per day; trace boys, from 40 to 52 cents per day; car cleaners, from 88 cents to $1 per day; drivers, conductors, and motormen, from $1 to $1.12 per day. These rates apply to Sundays and week days alike.

The rolling stock consists of 384 horse cars, 132 electric cars (47 only of which are now running), 17 omnibuses, 39 lorries, and numerous carts, wagons and vans. There are 4,411 horses.

Work is now progressing, with the object of changing the entire system to electric traction, which it is hoped to have completed within the next eighteen months. No underground conduits will be used, according to the present plans.

Fares range from 1 cent for first half mile to 2 cents for a mile; the longest ride is 6 miles, costing 6 cents. No transfers are issued, and tickets are not used.

The committee of the town council having supervision of the tramways receives no compensation. For that matter, however, no member of the city government of Glasgow, including lord provost, town councilors, and bailies (police judges), receives compensation.

The city of Glasgow has a population of about 850,000 and spreads over an area of nearly 12,000 acres.

There are no electric or other tramways extending out of Glasgow to other towns or cities. Within the city is an underground cable road which makes a circuit of about 5 miles and is owned and operated by a private company. The rate of fares on this road is about the same as that prevailing on the surface roads.—Samuel M. Taylor, Consul, Glasgow.

German Life Insurance in 1899.—Consul-General Guenther reports from Frankfort, July 14, 1900:

The most important statistics relative to German life insurance during the year 1899 are as follows:

The total number of companies was 44, against 42 in 1898. Three new companies were added—the Urania, of Dresden; Arminia, of Munich; and General German Insurance Company, of Stuttgart—while one company—the Life Insurance Company, of Baden—consolidated with the General Insurance Company, of Karlsruhe. Of the 44 companies, 22 are stock companies and 22 mutual ones. There were 152,828 policies issued for 598,679,825 marks ($142,485,798). The mortality rate during 1899 was favorable. The companies invest 76·8 per cent. of their capital in first-class mortgages, and avoid as much as possible other securities, which are subject to considerable fluctuations in value. Government and other exchange securities are quoted at an unusually low rate, probably because of the large demand for money for industrial enterprises.

Lamps in Austria.—In reply to inquiries from a New York association (which has received copy of the report), Consul Hossfeld, of Trieste, says:

The kerosene oil used in this consular district is the product of Russian crude petroleum. There have been during the past ten years no direct importations of American petroleum at Trieste.

I do not believe that American lamps would have to be equipped with special burners if Russian oil were used. In the lamps of Austrian manufacture, either Russian or American oil may be burned.

While some Belgian and German lamps are imported here, probably nine out of ten of all the lamps sold in this consular district are of Viennese manufacture. In fact, nearly all the principal lamp-makers of Vienna maintain branch houses at Trieste, as well as in the other large cities of the empire.

Prices are high, in some instances 30 or 50 per cent. more than in the United States.

I think that cheap lamps, especially, could be sold here to great advantage if our manufacturers would imitate the tactics of Viennese lamp-makers and open in the cities of Southern Austria stores of their own. No native can sell American wares in a foreign country as successfully as an American who is familiar with the language and customs of the country. This has in recent years been demonstrated in every large city of Europe. The American knows what most retailers in Southern Europe, at least, still have to learn, viz., how to advertise, how to display goods, how to meet competition, how to gratify and at the same time to educate the popular taste; and, above all, he knows how to "hustle." It is, moreover, difficult to induce a native retailer to buy foreign wares as long as their sale is still in the tentative stage.

As a great deal of latitude is left to customs officers in the classing of imported ware, it is always advisable to commence operations with trial shipments. The customs officers here, as elsewhere, are guided by precedents, and the importer who has once cleared a sample shipment knows just what duties he will have to pay on his various goods in the future.

All custom duties in Austria are specific and must be paid in gold (the gold florin being equal to 48·7 cents).

If the opening of American retail lamp stores abroad seems inexpedient, those of our manufacturers who are anxious to establish in Europe a permanent and profitable market for their wares should at least send traveling salesmen familiar with the languages and commercial customs of the countries in which they are expected to do business.

Anyone looking over the hotel registers of Trieste will find that fully one-fourth of the commercial travelers that come here are from Germany and Great Britain. If it pays Germany and England to send their "runners" here, why should it not pay the United States? Efficient salesmen with well-equipped sample cases will find more and better customers and will be cheaper in the end than the thousands of circulars which daily fill European waste-paper baskets.

Lamps in Marseilles.—The following extracts are from letters written by Consul Skinner, of Marseilles, to New York and Chicago firms.

There are several local manufacturers of lamps in Marseilles, and whether there is a future here for American goods depends upon the price. Lamps retail rather higher than in New York and are inferior in quality. Good reading lamps at modest prices, such as may be found in any American stock, are hard to obtain, the local assortments consisting usually of the two extremes in both price and quality.

The French burner is commonly provided with a lever, by which the chimney may be raised and the wick lighted without touching the hand to the glass. The device is practical and desirable. Efforts have been made to apply an incandescent burner—probably about the same thing as the American Welsbach gas burner—to petroleum lamps in this city, but the experiment was not successful.

The tariff imposed on lamps by the French government is as follows per 220 pounds:

Lamps of porcelain, glass, iron, brass, etc.	$11.58
Lamps of gold or silver plated metal	48.25
Lamps of nickel-plated metal	28.95

If the lamps are detachable, the tariff for the mounting is $1.54 per 220 pounds, the lamp reservoir and permanently connected parts paying as above.

The tariff schedules are so extended that the foregoing figures are tentative rather than positive. In introducing a new article, the only absolutely certain method of knowing the rate of duty would be to submit a sample for custom-house examination.

The popular illuminating agent in France continues to be the old-fashioned candle, and in most of the hotels gas has not been distributed through pipes beyond the offices and dining-rooms. In many of the very elegant private residences, more particularly those belonging to the old families of the country, the same condition prevails. On a ceremonial occasion, the halls and salons will be magnificently illuminated with wax tapers, distributed in large chandeliers and beautiful lusters, one of the latter in each of the four corners of every apartment. Among the plain people, gas is too expensive for ordinary use, and in many cities like Marseilles electricity is not to be employed at any price. After candles, the oil lamp is next in popularity. A great many people make use of certain simple processes of manufacturing acetylene gas. Devices for the production of this gas upon a small scale for use in lamps are for sale everywhere. A large number of cafés and institutions of that character have private acetylene-gas plants, and the arrangements for burning this gas have been so perfected that its use gives satisfaction.

The retail price of oil is 7 cents per liter (1·05 quarts), and for high-grade oils the price is considerably higher.

American Shirt-Waists and Underwear in England.—Until two days ago there had been no hot weather here, says Consul Marshall Halstead, of Birmingham, and the phenomenally backward season had an injurious effect on the business of jobbers and shopkeepers who had stocked summer fabrics and clothing. American-made ladies' shirt-waists have been a source of particular anxiety, as the best shopkeepers had this year very heavy stocks of them. A few consignments of these shirt-waists were put on the British market in the summer of 1898 and found a ready sale, for in neatness of fit and novelty of design they were very attractive and surprisingly superior in price to blouses of English or German make. In the spring of 1899 shopkeepers generally gave to dealers in American shirt-waists what they considered were exceptionally large orders, but the summer demand was far greater than anticipated. Consequently, shopkeepers put in still larger stocks for this summer's sale, but the unseasonable weather has so far interfered. There probably has never been an article of ladies' clothing which has so completely dominated the British market.

An American storekeeper's capital is in his stock, as he does not give long credit, while the capital of the British shopkeeper is represented on his books, for he gives very long and free credit, and, therefore, cannot have a big stock. On account of this small-stock custom, there still exists in England a type of jobber or small wholesaler long since wiped out in the United States, and manufacturers here are willing to accept small orders and to guarantee the filling of repeat orders.

The American manufacturers of shirt-waists have done nothing in the way of meeting small-order demands, and, while they have deserved their two seasons' success, owing to the merit of their articles, they must not expect the sale to continue unless they hereafter take care of the trade in the way customary here, for the British manufacturers have had their lesson and will compete next year. They will sell in small lots, and will call the article a blouse instead of a shirt-waist, and their salesmen will appeal to the shopkeepers to assist British industries by buying of those who employ British labor.

It is extraordinary that British shopkeepers have for two seasons stocked heavily with American blouses, and it can be attributed only to the great superiority of the American article; but they will not stock American blouses again if they can get British-made blouses of anywhere near the same attractiveness in small lots and with a guaranty that their second orders will be executed.

I have heard that one London merchant had sales of American shirt-waists totaling £57,000 ($277,390.50), and a salesman for a big wholesale house who traveled with me in a railway carriage the other day said that two-thirds of his blouse sales this year had been American. He had also sold some thousands of American braces (suspenders for men), and said it had made him smile when he met well-to-do Americans traveling here who, when questioned, boasted they wore "imported suspenders." He inspected, at my suggestion, the suspenders I was wearing (bought in New York for fifty cents), and said that their equal could not be produced here or in France for that price at wholesale.

An American manufacturer who has called at the consulate told me that, finding several years ago he could no longer compete in common cottons at his New England mill with the cheap labor of North Carolina, he sold his old machinery to a company then building a Southern mill and studied the processes of suspender manufacture here and on the Continent. He boasted that while the British manufacturer had only about eighteen styles, he manufactured one hundred and fifty-eight styles his first season, and claimed his suspenders were better and cheaper, for he had adopted all the good processes, rejecting those he thought merely traditional, and had put in labor-saving machinery, some of which he had invented, the rest being designed by clever men whom he employed for the purpose.

American manufacturers of all garments for ladies' underwear of the many cotton and semi-silk kinds can, if they adopt the proper merchandising methods, more than duplicate the success of the shirt-waist manufacturers in Great Britain. By a well-planned campaign, they could simply take command of the market and furnish shopkeepers with articles which would, I am certain, be a revelation to their customers. American ladies living in England frequently write home for underwear. Sometimes they have them made here with their old garments as models, but even then are seldom satisfied with either the fit or the needlework. No. 40 cotton is used here, where No. 60 serves in the United States, and there is absolute disbelief of the statement that "200 thread" is sometimes used. Sewing is being carefully taught in the public schools, and as a merit reward the most proficient are permitted and encouraged to use No. 100 cotton thread. There would at first glance seem to be advantage in using No. 24 thread for sewing on buttons—it is used here for that purpose—but think what holes must be made in delicate fabric with 24 thread and a needle big enough to carry it.

American ladies have difficulty in procuring hose of full length and reasonable shapeliness. The type of hose in general use is short—a knee length only—as side garters are little known or used, though a few of the better-class stores now keep the "velvet clasp"; but there is positively no shaping for foot or ankle.

Men's black cotton socks I find it impossible to buy in shops here with tops at all elastic. I am told that the fast-black dye for cotton was the discovery of an English chemist; that English hose manufacturers would not at first buy his secret; that the Germans did, and built up a trade all over the world. It may not be out of place here to state that several years ago one of the Barbers (of thread-making fame) told me the discoverer of a fast-black dye for linen thread could command his own price. Examine the thread holding the buttons in men's clothing, and you will see that after a short time the black disappears, and even new linen thread has not sufficient depth of color.

Siamese Demand for Railway Materials and Firearms.—Minister King, of Bangkok, under date of June 20, 1900, informs the Department that he has succeeded in securing an open tender for American manufactures in the construction of the Petchaburee Railroad by the Siamese government. Bids for the construction of a plant for the manufacture of ammunition in that country were opened to American competition in March, and a bid was asked from the United States on 20,000 rifles and 10,000,000 cartridges.

Brazilian Market for Porcelain and Glass.—Minister Bryan writes from Petropolis, July 9, 1900, that one of the leading importers of china and glass in Rio de Janeiro has informed him that his firm has successfully placed United States glassware on sale, the action having been taken at the recommendation of United States Consul-General Seeger. Mr. Bryan expresses the belief that with small effort, this branch of trade can be extended in Brazil. He sends for distribution among the manufacturers, through the bureau of the American Republics, a list of dealers in these articles in Rio de Janeiro.

Washout on Guatemala Railway.—Consul-General McNally reports from Guatemala, July 27, 1900, that owing to the heavy rains a serious washout has occurred on the Northern Railway, which extends from Puerto Barrios to El Rancho. Several bridges have been destroyed, and traffic is interrupted. The mails from the United States are delayed four or five days. The government has appointed a corps of engineers to estimate the damages, with a view to immediately repairing the line.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

LEROY'S OIL FEEDER.

M. LEROY, who has made a specialty of the products and apparatus used for the lubrication of machinery, has recently devised an ingenious oil feeder, which we illustrate herewith. As well known, the least of the defects of the ordinary oil feeder resides in the inequality of its discharge, which passes instantaneously from insufficiency to excess. The result of this is inevitable losses of oil; and, since the operation of lubrication is sometimes repeated at short intervals of time, the output becomes excessive.

The object of M. Leroy's oil feeder is to remedy such an inconvenience. The apparatus consists of an iron plate reservoir, *A*, into the bottom, *B*, of which is screwed a hollow plug, *E*, which receives a ball, *D*, that forms a suction valve, of which the seat communicates with the oil reservoir through small channels. This reservoir is traversed by a partitioned tube, *C*, to which are adapted all the parts of the pump. At one of the extremities of this tube is placed the force valve, the ball of which is held upon its seat through a small spring compressed by a screw plug, *I*.

LEROY'S OIL-FEEDER.

The operator passes his fore and middle finger through the ring of the apparatus, while his thumb remains free to act upon the button, *G*, of a piston bearing against a spring, *N*, placed in the inclined part of the tube, *C*. After the pump has been primed, every pressure upon the button forces oil in a corresponding measure. When the operator ceases to bear upon it, the spring, *H*, pushes the piston back to its initial position and again brings about the filling of the box of the ball valves.

This little apparatus, therefore, does not permit of an undue flow of oil from the reservoir, and offers the operator every facility for regulating the discharge of it, so that the use of the device is capable of causing a notable saving in the expense of lubrication.—Revue Industrielle.

HIGH-SPEED ENGINE AND ALTERNATOR.

THE illustration represents a combined engine and dynamo—the former made by J. and H. M'Laren, of Leeds, and the latter by Siemens Brothers and Company. The combined plant is at work at the Electric Generating Station of the Harrogate Corporation. The engine is of 600 indicated horse-power, and it runs at 333 revolutions per minute. It is of the triple-expansion enclosed type, and works with forced lubrication. Each cylinder is fitted with its own balanced slide valve, and the governor acts only on the high-pressure valve, the cut-off in the intermediate and low-pressure valves being fixed. The initial steam pressure is low for a triple-expansion engine, being only 130 pounds on the square inch. The steam consumption, we are informed, however, came out at under 22 pounds of steam per kilowatt hour at full load, which not only speaks well for the engine, but also for the alternator as well. Superheated steam is employed. This economy in working is without doubt due, in considerable degree, to the care with which the cylinders are jacketed. The jacket is carried not only all round, but on the ends as well as up the back of the intermediate steam chest. The engines have no receivers, and the steam chests are kept as small as possible. The exhaust, when passing from cylinder to cylinder, is carried round and kept in contact with the outside of the cylinder jackets. This, of course, constitutes to a certain extent a re-heating arrangement. All the slides being balanced, also permits of their working with super-heated steam without fear of damage or cutting. The cylinders of this engine are 16-inch, 22½-inch, and 32-inch diameter by 1-foot stroke. The crank shaft is 6 inch diameter, the piston-rods are 3⅛-inch diameter, and the connecting-rods 3⅝-inch diameter.

The alternator is of the Siemens W18 / 6¾ type, with revolving armature, the cores of the armature coils being free from iron. The output is 150 amperes, 2,000 to 2,100 volts at 333 revolutions per minute, the frequency being fifty complete periods per second. The machine will stand a 20 per cent. overload. It has a direct coupled exciter of the Siemens HB type. The alternator has sixteen bobbins on the armature, and thirty-two field bobbins.

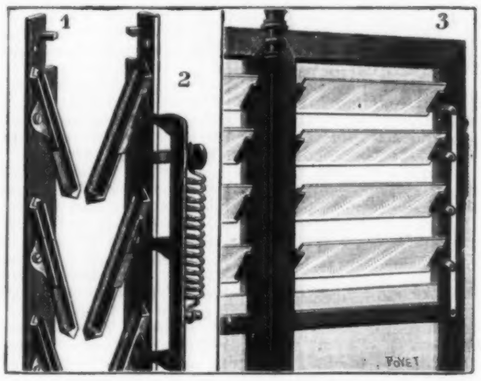
We understand that the working of this plant during the year that it has been in operation has been so satisfactory that an exact repeat order has been given.

For our engraving and the foregoing particulars we are indebted to The Engineer.

THE GUZZI AERATOR.

THE Guzzi aerator, represented herewith, is designed to be used as a substitute for the ordinary glazed window sash. It consists of a number of overlapping strips of glass, the extremities of which are inserted in holders that pivot upon an upright formed of thin tinned iron secured to the sides of the window frame by means of a few screws. A special arrangement placed at one of the sides permits of varying the inclination of the strips, which operates like the slats of a Venetian blind. To this effect, the upright carries a small arm, which, through the intermedium of a vertical rod, controls all the pivoted levers, which form part of the holders placed at the same side. This rod, upon being worked upward or downward, causes all the holders or mountings to assume a position approaching the vertical or horizontal, and thus opens or closes the aerator.

A spiral spring, which acts upon the lever rod, automatically pulls the holders back and maintains them in such a position as to keep the slats closed. In order to place the latter at any inclination whatever, the tension of the opposing spring is overcome by pulling a chain suspended from the maneuvering rod, and the links of which are arranged in such a way as to embrace the square head of a screw fixed to the sides of the frame. Ten links thus mark as many stoppages, each corresponding to an inclination that varies from the vertical closed to the horizontal wide-open position.

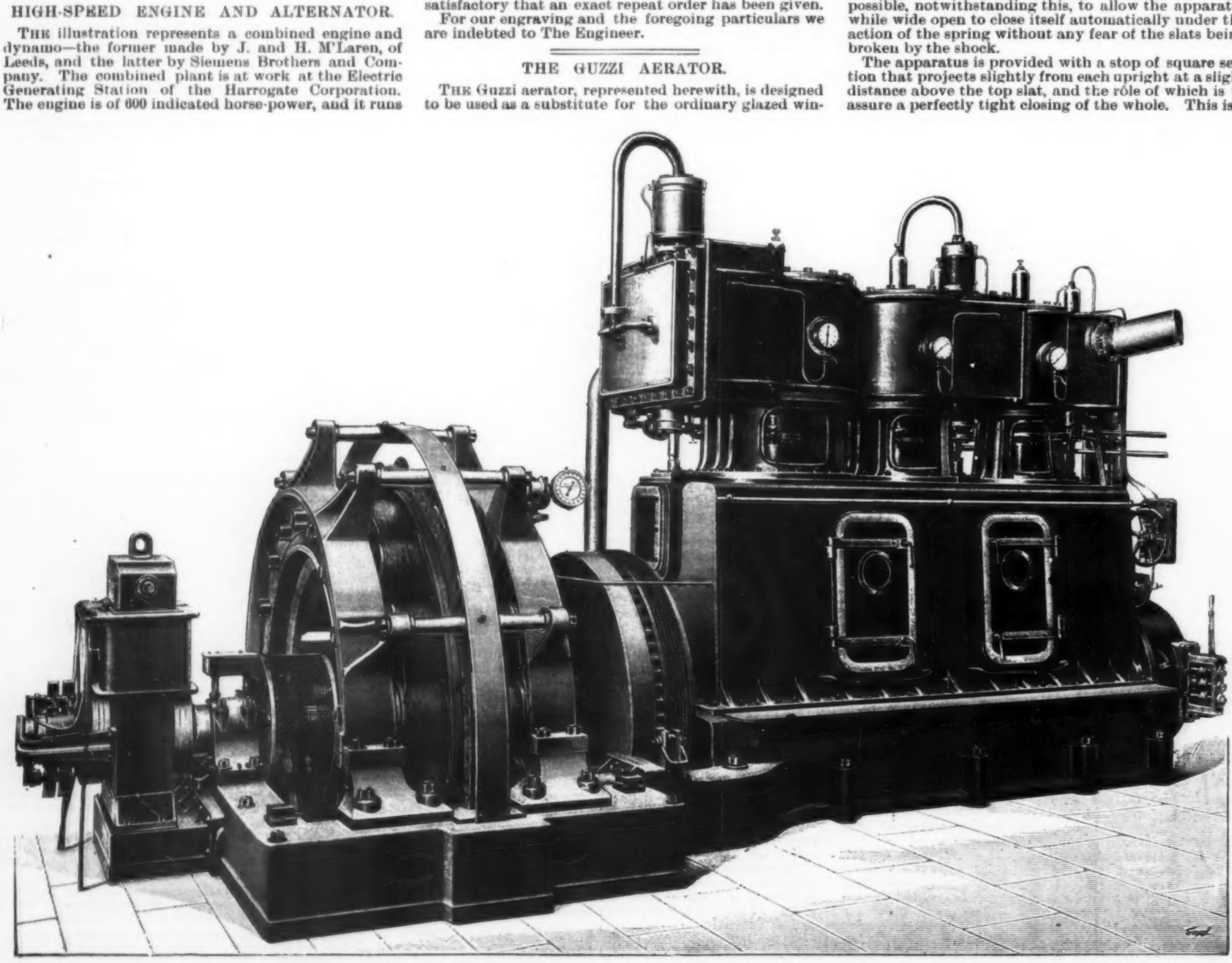


THE GUZZI AERATOR.

1 and 2. Slat holders. 3. Holders in place.

The apparatus is strong and not very bulky. As a consequence of the care used in its construction, and particularly of the manufacture of the holders from a special alloy, the slats may be inserted in their mountings without the necessity of using any putty. It is possible, notwithstanding this, to allow the apparatus while wide open to close itself automatically under the action of the spring without any fear of the slats being broken by the shock.

The apparatus is provided with a stop of square section that projects slightly from each upright at a slight distance above the top slat, and the rôle of which is to assure a perfectly tight closing of the whole. This is a



COMBINED ENGINE AND DYNAMO, HARROGATE ELECTRIC LIGHTING STATION.

matter of some importance in aerators situated on a ground floor, since, without such a precaution, any evil-disposed passer-by might, by means of a cane, push the top slat out of its holder, and then the other slats in succession, and thus form a passage for himself without breaking anything and without making any noise. The Guzzi aerator is thus rendered as safe as a glazed window sash. This arrangement is completed by the form of the slat holders, which are so shaped at the lower part that in a closed position they fit into one another and the one above forms a stop for the one beneath when the aerator is closed. Each strip of glass is thus easily mounted or replaced when the aerator is open, and is immovable when it is closed. These are details of construction to which the apparatus owes its principal merit.

The inconveniences of a want of air in small or over-crowded habitations, and the diseases that are the result thereof, are well known. The use of the Guzzi aerator, which affords a continuous and regular supply of air, prevents the evil and renders the remedy unnecessary.

Windows that open may also serve for the renewal of air, of course; but a window cannot always be left open on account of the rain, wind and dust, as well as the draughts of cold air that may enter to the annoyance and injury of the occupant of a room. The opening of a window, especially in winter, produces alternations of heat and cold that are very prejudicial to health, and to which is often and unconsciously preferred asphyxia by vitiated air.

With the Guzzi aerator the harsh and intermittent action of the open window is advantageously replaced by a slow and continuous action. Fresh air constantly enters near the ceiling and becomes heated in the upper portions of the room before descending to the lower ones and there diffusing its vivifying action.

The entrance of the air takes place regularly and uninterruptedly, and in a sure although insensible manner. It is possible to sleep in a bedroom provided with a Guzzi aerator without any fear of the inconveniences attending an open window. Mr. Guzzi's apparatus is, therefore, interesting in that it realizes one of the most important disiderata of hygiene. The use of it is indicated wherever a swinging window may prove an inconvenience (for instance, in kitchens, ante-chambers, water closets, etc.), and wherever ventilation is necessary (say in offices, workshops, schoolrooms, bedrooms, cafés, stores, etc.).—La Nature.

DAIRY DEVELOPMENT IN THE UNITED STATES.*

By Henry E. Alvord, Chief of Dairy Division, Bureau of Animal Industry.

The Present Field of the Dairy Industry.

No branch of agriculture in the United States has made greater progress than dairying during the nineteenth century. No other has received more direct benefit from the art of invention, the teachings of modern science, and the intelligent practice of skilled operators. Co-operative and commercial organizations have been formed to conduct the business locally and to guard its general interests. State laws and appropriations of money have been made to foster and promote this industry. Dairying has become the specialty of districts of wide area in different parts of the country. It is now regarded as among the most progressive and highly developed forms of farming in the United States.

Dairying During the Colonial Period and at the Present Time.

Dairying was practiced in this country in colonial times, and butter and cheese are mentioned among the early exports from the settlements along the Atlantic coast; but this production was only a feature of general and pioneer farming. Dairying as a specialty did not appear in the United States to any extent until well along in the nineteenth century. The dairy history of the country is, therefore, identical with its progress in the present century. This progress has been truly remarkable. The wide territorial extension; the immense investment in lands, buildings, animals and equipment; the great improvement in dairy cattle; the acquisition and diffusion of knowledge as to economy of production; the revolution in methods and systems of manufacture; the general advance in quality of products; the wonderful increase in quantity; the industrial and commercial importance of dairying, all constitute a prominent feature in the material progress of the nation.

Dairying During the Early Part of the Century.

During the early part of the century the keeping of cows on American farms was incident to the general work. The care of milk and the making of butter and cheese were in the hands of the women of the household, and the methods and utensils were crude. The average quality of the products was inferior, the supply of domestic markets was unorganized and irregular. The milch cows in use belonged to the mixed and indescribable race of "native" cattle, with occasionally a really good dairy animal appearing singly, almost by accident, or, at the best, as one of a family developed by some uncommonly discriminating yet unscientific breeder. The cows calved almost universally in the spring, and were generally allowed to go dry in the autumn or early winter. Winter dairying was practically unknown. As a rule, excepting the pasture season, cattle were insufficiently and unprofitably fed and poorly housed, if at all. It was a common thing for cows to die of starvation and exposure, and it was considered no disgrace to owners to have their cattle "on the lift"* in the spring. In the Eastern and Middle States the milk was usually set in small shallow earthen vessels or tin pans for the cream to rise. Little attention was paid to cooling the air in which it stood in summer or to moderating it in winter so long as freezing was prevented. The few who scalded fresh milk had no idea of the true reason for so doing or why beneficial effects resulted. The pans of milk oftener stood in pantries and cellars or on kitchen shelves than in rooms specially constructed or adapted to the purpose. In southern Pennsylvania and the States farther south spring houses were in vogue; milk received care, and setting it in earthen crocks or pots, standing in cool, flowing water, was a usual and excellent practice. Churning the entire milk was very common. This is still done to some extent in the Southern States, where butter is made every morning and where all the milk is buttermilk. In seasons of scarcity of milk there was no butter. In the Northern States there were some instances where families were supplied with butter weekly during most of the year, and with an occasional cheese, directly from the producers. But the general farm practice was to "pack" the butter in firkins, half firkins, tubs and jars, and let the cheese accumulate on the farm, taking these products to market only once or twice a year. Not only were there as many different lots and kinds of butter and cheese as there were producing farms, but the product of a single farm varied in character and quality according to season and other circumstances. Every package had to be examined, graded, and sold upon its merits. It was usual for half the butter in market to be strong, if not actually rancid, and for cheese to be sharp. With the products largely low in grade, prices were also very low.

Dairying During the Middle of the Century.

The above conditions continued without material change up to the middle of the century. Some improvement was noticeable in cattle and appliances, and in some sections dairy farming became a specialty, although not in a marked degree.

All the operations of the dairy continued rude and undeveloped even in these "dairying districts." The cows were milked in the open yard, and the curds were worked in home-made tubs and pressed in log presses. Everything was done by guess; there was no order, no system, no science in dairy operations. The cheese-making section gradually embraced the central and western portions of New York and the adjacent parts of Pennsylvania and Ohio, and the total production became large. Toward the middle of the century the gross supply of cheese was in excess of domestic demand, and cheese exports from the United States, mainly to Great Britain, ranged from 3,000,000 to 17,000,000 pounds a year. With the growth of cities and towns the business of milk supply increased and better methods prevailed. Yet, prior to the year 1850, no city had received any part of its milk supply by railroad transportation; near-by producers met all existing demands by hauling in their own vehicles. Butter making for home use and in a small way for local trade was common wherever cows were kept, and in some places there was a surplus sufficient to be sent to the large markets. Vermont and New York became particularly noted for butter production. "Franklin County butter," from counties of this name in those two States and in Massachusetts, was the favorite in New England markets, and the fame of "Orange County" and "Goshen" butter, from southern New York, was still more extensive.

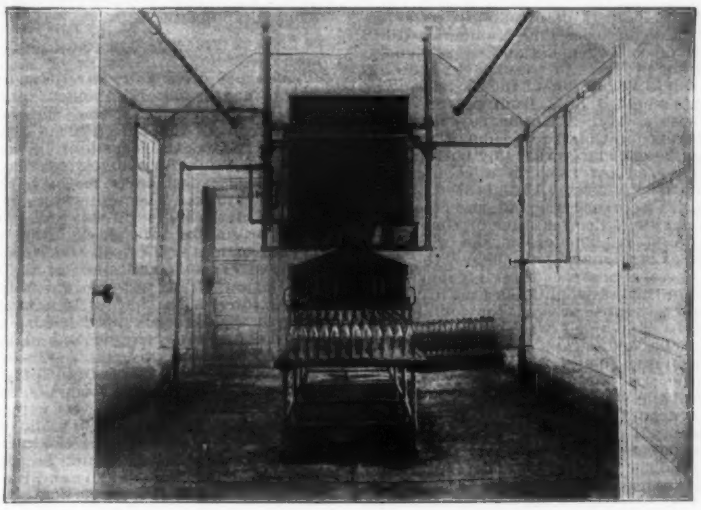


Fig. 2.—COOLING AND BOTTLING ROOM ON A DAIRY FARM IN PENNSYLVANIA.

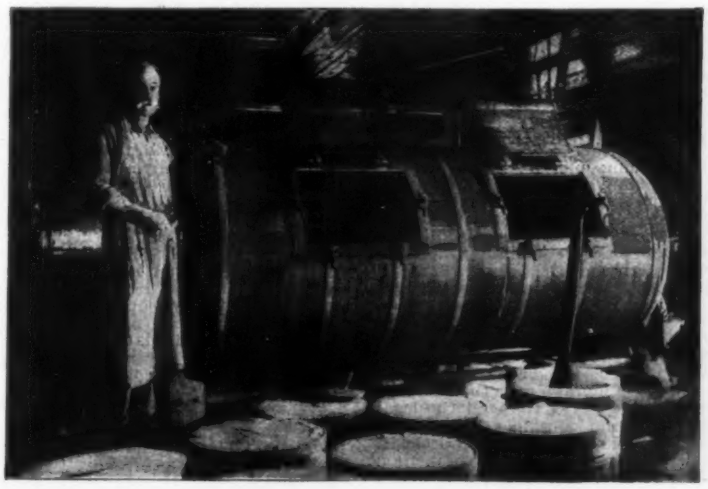


Fig. 1.—BUTTER MAKING ON A LARGE SCALE.

Dairying During the Third Quarter of the Century.

The twenty-five years following 1850 was a period of remarkable activity and progress in the dairy interests of the country. At first the agricultural exhibitions or "cattle shows," which were comparatively new and popular, and the enterprise of importers turned attention toward the improvement of farm animals; breeds of cattle noted particularly for dairy qualities were introduced and began to win the favor of dairy farmers. Then the early efforts at co-operation in dairying were recognized as successful, and were copied until the cheese factory became an established institution. Once fairly started in the heart of the cheese-making district of New York, the factory system spread with much rapidity.

SOME FEATURES OF THE FACTORY SYSTEM.

The effect of the establishment of cheese and butter factories, comparatively new in kind, is to transfer the making of butter and cheese from the farm to the factory. Originating in this country, although now extensively adopted in others, the general plan may be rightly called "The American system of associated dairying." It constitutes one of the notable and important landmarks in the progress of dairying during the present century. The early cheese factories and creameries were purely co-operative concerns, and it is in this form that the system has usually extended into new territory, whether for the production of butter or cheese. The cow owners and producers of milk co-operate and share, upon any agreed basis, in organizing, building (or renting and refitting), equipping, and managing the factory and disposing of its products. The farmers interested as joint owners, and all who contribute milk or cream, are called the patrons. The operations are managed by a committee or board of directors chosen by and from the patrons. If the business is large enough to warrant the expense, the immediate supervision of the concern and all its interests is intrusted to a single manager, employed by the board. In a factory of this kind all expenses are deducted from the gross receipts from sales and the remainder is divided pro rata among the patrons upon the basis of the raw material contributed. Another plan is for the plant to be owned by a joint stock company, composed largely, if not wholly, of farmers, and milk or cream is received from any satisfactory producer. In this case interest on the property or capital is usually allowed and included in the current expenses. The management is otherwise the same; the stockholders receive a

* From the Yearbook of the Department of Agriculture for 1899.

* A common expression in years past in some localities, indicating the actual necessity of human aid to raise emaciated animals to their feet.

fixed rate of interest on their investment and the dividends to patrons depend upon their deliveries of milk or cream and the fluctuations of the market for the factory products. The proprietary plan is also common, being managed much like any other factory; the proprietor or company buys the milk or cream from the producers at prices mutually agreed upon from time to time, and assumes all the expenses, risks, and returns of the business. Another way is for the factory, whether owned and managed by a company of farmers (probably themselves patrons), or by outsiders, to bear all expenses, make and sell the butter and cheese at a fixed charge per pound, and divide the net proceeds of sales as on the purely co-operative plan. All these plans are varied and modified in practice.

METHODS OF MANAGEMENT OF CHEESE AND BUTTER FACTORIES.

Independent of the matters of ownership, organization, and control, the factories and creameries differ much in methods of management and of settlement with patrons. Great progress in these particulars has been made since the introduction of the system. The first establishments received milk from patrons daily and sometimes twice a day. From near-by farms the milk was often warm from the cow at time of delivery. The milk was then kept in large vats (for cheese making) or in immense shallow pans in a cooling and creaming room until skimmed. Abundant room and expensive receptacles were necessary at the creamery. Then, for butter making, deep setting of the milk in cool water was adopted. The creameries were provided with pools or stationary vats below the floor level. Through these, cool water flowed from springs near at hand, and in them the milk was set in "shotgun" cans immediately after arrival, for cooling and for cream to form. The pools were 18 or 20 inches deep, with racks at bottom to hold cans. The tin cans were 22 inches deep and 8 inches in diameter and filled so that when in the pool the top of the milk was just below the surface of the water. Springs with abundant flow and having a natural temperature of 48° to 56° F. were regarded as highly desirable. Afterward came the method of mechanical cream separation (to be later described) in place of "setting," or the gravity system. Another radical change, which began about 1875, was to set and skim the milk on the farms and haul only cream to the factories. Agents from the creameries, with suitable teams and carrying cans, drove from farm to farm and gathered the cream. Hence, the name of "gathered-cream factories" for establishments of this class. This kind of factory is still the favorite in some good butter districts, and it has very decided merits. The earliest factories and creameries paid for milk by the quart or gallon and at the same price, all lots of equal bulk being regarded as of equal value. The first step in advance on this line was to buy or credit milk by weight, but still all at the same price. On the gathered-cream plan, equal bulk measures of cream were long regarded as of like value, and this is still practiced to some extent. The most modern and approved plan is to pay for the milk or cream received by factory or creamery according to the pounds of fat it actually contains as experimentally determined. This will be referred to later. At first it was considered sufficient to have 300 cows tributary to a factory, and patrons were expected to be located within a mile or two, and 4 or 5 miles was the maximum haul. Larger factories were soon favored as more economical, and very large ones have been lately put in operation, each receiving the daily product of thousands of cows. Milk and cream is hauled twice as far as formerly to patronize a factory, and often by co-operation among the farmers along a "route." All patrons are now expected to cool their milk thoroughly before it leaves the farm. In the latest form of creamery management, cream is collected over many square miles of territory and transported long distances by rail to be made into butter at a central factory.

APPLICATION OF MECHANICS TO THE DAIRY.

The third quarter of the century was also a period of unprecedented progress in the application of mechanics to the dairy. The factories and creameries required new equipment, adapted to manufacture upon an enlarged scale, and equal attention was paid to the improvement of appliances for farm dairies. Shallow pans were changed in shape and greatly enlarged; some were made to hold 20 or 30 gallons, and had bottom and sides double for cooling or warming by the water jacket. Then these big pans, and most others, disappeared in favor of deep setting. This system, in which deep cans were used, set in cold water, preferably iced water, was introduced from Sweden, although the same principles had been in practice for generations in the spring-houses of the South. Numerous creaming appliances, or creamers, were invented, based upon this system. Butter workers of various models, most of them employing the lever, or a crank and roller, took the place of the bowl and ladle and the use of the bare hand. Churns appeared of all shapes, sizes, and kinds, the general plan being to abolish dashers and substitute the agitation of cream for violent beating.

DAIRYING DURING THE CLOSING DECADES OF THE CENTURY.

The development of dairying in the United States during the closing decades of the nineteenth century has been uninterrupted and marked by events of the greatest consequence in its entire history. The importance of two inventions during this period cannot be overestimated.

The first is the application of centrifugal force to the separation of cream from milk. This is based upon the fact that the specific gravity of milk serum, or skim milk, is greater than that of the fatty portion, or cream. The dairy centrifuge, or cream separator, enables the creaming or "skimming" to be done immediately after milking, preferably while the milk has its natural warmth. The cream can be churned at once, while sweet, but the better and usual practice is to cool thoroughly and then slowly cure, or "ripen," it for churning. The cream can be held at a comparatively high temperature, avoiding the necessity of much ice or cold water. The skim milk is available for use while still warm, quite sweet, and in its best condition for feeding to young animals. This mechanical method is more efficient than the old gravity system, securing more perfect separation and preventing loss of fat in the skim milk. It also largely reduces the dairy labor. The handling and care of the milk may be thus wholly removed from the duties of the household. In creamery practice the milk is usually aired and cooled on the patrons' farms and hauled once a day to the factory; there it is warmed to facilitate the work, passed through the separator, and the skim milk may be at once hauled back to the farms. A creamery uses one or more separators of large capacity, operated by power. This practice involves the double haul and an apparent waste of the farmer's time and labor. A movement toward economy in this respect is the establishment of "skimming stations" at convenient points," equipped with one or more power separators; to these the milk is taken for separation from the farms in the vicinity, and from these stations the cream is carried to the central factory for curing and churning.

FAT TEST FOR MILK.

The second great dairy invention of the period is the popular fat test for milk, being a quick and easy substitute for chemical analysis. This is one of the public benefactions of the agricultural experiment stations. In several States these stations have done much creditable work in dairy investigation, and from them have come several clever methods for testing the fat content of milk. The one which has been generally approved and adopted in this and other lands is named for its originator, Dr. S. M. Babcock, chemist and dairy investigator, first of the New York experiment station at Geneva and since of the Wisconsin experiment station. This test combines the principle of centrifugal force with simple chemical action. The machine on the Babcock plan has been made in a great variety of patterns, simple and inexpensive for home use and more elaborate and substantial for factories. By these machines from two to forty samples may be tested at once in a few moments, and by the use of bottles specially provided the percentage of fat may be determined in samples of milk, cream, skim milk, or buttermilk. Of course, the glassware appurtenances of these testers must be mathematically accurate. Besides the machine and its fittings, the only supplies needed are sulphuric acid of standard strength and warm water. Any person of intelligence can soon learn to make ordinary tests with this appliance, but care and skill are necessary to absolutely correct results.

DAIRYING AT THE PRESENT TIME.

The advent of the twentieth century will find the dairy industry of the United States established upon a plane far above the crude and variable domestic art of three or four generations ago. The milch cow itself, upon which the whole business rests, is almost as much a machine as a natural product, and, as already shown, a very different creature from the average animal of the olden time. Instead of a few homely and inconvenient implements for use in the laborious duties of the dairy, perfected appliances, skillfully devised to accomplish their object and lighten labor, are provided all along the way. Long rows of shining tin pans no longer adorn rural dooryards. The factory system of co-operative or concentrated manufacture has so far taken the place of home dairying that in entire States the cheese vat or press is as rare as the handloom, and in many counties it is as hard to find a farm churn as a spinning wheel.

METHOD OF MILKING UNCHANGED.

In one respect dairy labor is the same as a hundred years ago. Cows still have to be milked by hand. Although numerous attempts have been made, and patent after patent has been issued, no mechanical contrivance has yet been a practical success as a substitute for the human hand in milking. Therefore, twice a day, every day in the year, the dairy cows must be milked by manual labor. This is one of the main items of labor in dairying, as well as a most delicate and important duty. Allowing ten cows per hour to a milker, which means lively work, it requires the continuous service of an army of 300,000 men, working ten or twelve hours a day throughout the year, to milk the cows kept in the United States.

MILK PRODUCTION.

The business of producing milk for town and city supply, with the accompanying agencies for transportation and distribution, has grown to immense proportions. In many places the milk trade is regulated and supervised by excellent municipal ordinances, which have done much to prevent adulteration and improve the average quality of the supply. Full as much, however, is being done by private enterprise, through large milk companies, well organized and equipped, and establishments which make a specialty of serving milk and cream of fixed quality and exceptional purity. These efforts to furnish "certified" and "guaranteed" milk and general competition for the best class of trade are doing more to raise the standard of quality and improve the service than all the legal measures. The buildings and equipment of some of these modern dairies are quite beyond precedent. This branch of dairying is advancing fast, and upon the substantial basis of care, cleanliness, and better sanitary conditions.

CHEESE MAKING.

Cheese making has been transferred bodily from the realm of domestic arts to that of manufactures. Farm-made cheeses are hard to find anywhere; they are used only locally, and make no impression upon the markets. In the middle of the century about 100,000,000 pounds of cheese was made yearly in the United States, and all of it in farm dairies. At the close of the century the annual production of the country will be about 300,000,000 pounds, and 96 or 97 per cent of this will be made in factories. Of these establishments there are nearly 3,000, but they vary greatly in capacity, and many are very small. New York and Wisconsin each has a thousand. The former State makes nearly twice as much cheese as the latter, and the two together produce three-fourths of the entire output of the country. The other cheese-making States, in the order of quantity produced, are Ohio, Illinois, Michigan, and Pennsylvania; but these are all comparatively unimportant. A change observed as taking place in the factory system is that of bringing a number of factories previously independent into a "combination" or under the same management. This tends to improve the quality and secure greater uniformity in the product, and often reduces cost of manufacture, all being decided advantages. More than nine-tenths of all cheese made is of the familiar standard variety, copied after the English Cheddar, but new kinds and imitations of foreign varieties are increasing. The cheese made in the country, with the small importations added, gives a yearly allowance of less than 4 pounds to every person; but as 30,000,000 to 50,000,000 pounds are still annually exported, the per capita consumption of cheese in the United States does not exceed 3½ pounds per annum. This is a very low rate, much less than in most European countries.

BUTTER MAKING.

Great as the growth of the associated system of butter making has been and fast as creameries have multiplied, especially in the newer and growing agricultural States, such as Minnesota, Nebraska, Kansas, South Dakota, and Washington, there is still much more butter made on farms in the United States than in creameries. Creamery butter controls all the large markets, the dairy products making comparatively little impression on the trade; but home consumption and the supply of small customers and local markets make an immense aggregate, being fully two-thirds of all. Estimating the annual butter product of the country at 1,400,000,000 pounds, not much over 400,000,000 of this is made in the 7,500 or 8,000 creameries now in operation. Iowa is the greatest butter-producing State and the one in which the greater proportion is made on the factory plan. This State has 780 creameries, only two counties being without them; about two-fifths are co-operative. In these creameries about 88,000,000 pounds of butter are yearly made from 624,000 cows. It is estimated that in the same State 50,000,000 pounds of butter in addition are made in farm dairies. The total butter product of this State is, therefore, one-tenth of all made in the Union. Iowa sends over 80,000,000 pounds of butter every year into other States. New York is next in importance as a butter-making State, and then come, in order, Pennsylvania, Illinois, Wisconsin, Minnesota, Ohio, and Kansas. Yet all of these combined make but little more than one-half of the annual butter crop of the United States, and in no one of them except Iowa is half of the butter produced made in creameries. The average quality of butter in America has materially improved since the introduction of the creamery system and the use of modern appliances, and the average continues to improve. Nevertheless, a vast quantity of poor butter is made—enough to make a large and profitable business in collecting it at country stores at grease prices or a little better and rendering or renovating it by patent processes. This renovated butter has been fraudulently sold to a considerable extent as the true creamery article, of which it is a fair imitation while fresh, and several States have recently made laws to identify the product and prevent buyers from being deceived. No butter is imported into this country, and the quantity exported is as yet insignificant, although there is beginning to be a foreign demand for American butter. The home consumption must accordingly be at the yearly rate of 20 pounds to the person, or about 100 pounds annually to the family of average size. If approximately correct, this shows Americans to be the greatest butter-eating people in the world.

The people of this country also consume millions of pounds every year of butter substitutes and imitations, such as oleomargarine and butterine. Most of this is believed to be butter by those who use it, and the State dairy commissioners mentioned are largely occupied in the execution of laws intended to protect consumers from these butter frauds.

BY-PRODUCTS OF DAIRYING.

Within recent years there has been great development in the economical uses of the by-products of dairying. Ten years ago there were enormous quantities of skim milk and buttermilk from the creameries and of whey from cheese factories, which were absolutely wasted. At farm dairies these by-products are generally used to advantage in feeding animals, but at the factories, especially at the seasons of greatest milk supply, this most desirable method of utilization is largely impracticable. In many places new branches have lately been added to the industry, which make sugar of milk and some other commercial products from whey, and utilize skim milk in various ways. The albumen of the latter is extracted for use with food products and in the arts. The casein is desiccated and prepared as a baking supply and substitute for eggs, as the basis of an enamel paint, as a substitute for glue in paper sizing, and it is also solidified so as to make excellent buttons, combs, brush backs, handles, electrical insulators, and similar articles.

NUMBER OF COWS AND QUANTITY AND VALUE OF DAIRY PRODUCTS.

The cows in the United States were not counted until 1840, but have been since enumerated for every decennial census. It has required from 23 to 27 cows to every hundred of the population to keep the country supplied with milk, butter and cheese, and provide for the export of dairy products. The export trade has fluctuated much, but has never exceeded the produce of 500,000 cows. With the closing years of the century it is estimated that there is one milch cow in the United States for every four persons. This makes the total number of cows about 17,500,000. They are unevenly distributed over the country, being largely concentrated in the great dairy States. Thus, Iowa leads with 1,500,000 cows, followed by New York with almost as many; then Illinois and Pennsylvania, with about 1,000,000 each. The States having over 500,000 each are Wisconsin, Ohio, Kansas, Missouri, Minnesota, Nebraska and Indiana. Texas is credited with 700,000 cows, but very few of them are dairy animals. In the Middle and Eastern States the milk product goes very largely to the supply of the numerous large towns and cities. In the Central West and Northwest butter is the principal dairy product. The following table gives approximately an exhibit of the quantity and value of

the dairy products of the United States in the year 1899:

ESTIMATED NUMBER OF COWS AND QUANTITY AND VALUE OF DAIRY PRODUCTS.

Cows.	Product.	Rate of product per cow.	Total product.	Rate of value.	Total value.
11,000,000	Butter.	130 lb.	1 430,000,000 lb.	$0.18	$257,400,000
1,000,000	Cheese.	300 lb.	300,000,000 lb.	.09	27,000,000
5,500,000	Milk.	380 gals.	2,090,000,000 gals.	.08	167,200,000

This gives the grand total of the dairy products of the country a value of $451,600,000. If to this be added the skim milk, buttermilk, and whey, at their proper feeding value, and the calves dropped yearly, the annual aggregate value of the produce of the dairy cows exceeds $500,000,000. Accepting these estimates as conservative, they show that the commercial importance of the dairying of the United States is such as to command attention and justify all reasonable provisions for guarding its interests.

COURTOL, THE VIPER-KILLER.

THE accompanying engraving, from La Nature, represents M. Courtol, the official viper-killer of the Prefecture of Haute Loire (France), which pays him five cents for the head of every reptile that he destroys. He captures, on an average, fifteen hundred of the ophidians a year, and, during one year, as shown by official records, his victims numbered 2,502.

The viper, when at rest, is not easily observed, since, by mimicry, it assumes the color of the ground or rocks of the locality that it inhabits, becoming bluish black upon basaltic rocks and reddish upon volcanic scoriæ. Moreover, according to Courtol, the viper, before coiling to take its siesta, "chooses its bed," that is to say, seeks ground that has a color which matches that of its skin.

M. Courtol has manufactured for himself two suits of clothes from the skins of his victims, one of them, such as he is seen wearing in the engraving, consisting of a pointed cap, jacket, waistcoat and trousers, and the other in the style of Louis XV. For each of these suits he employed nine hundred skins of venomous reptiles.

THE PACKING AND PRESERVATION OF MERCHANDISE IN THE TROPICS.*

ONE of the earliest experiences of most merchants who send goods to tropical countries is an unexpected loss which is traceable to the influence of a climate with which they are probably not familiar. The effect of climate must be considered apart from all other risks due to accident or violence, and they may be summed up under the heads of heat, damp, and vermin. Heat, as it is found in rainless and intensely dry countries like the Nile Valley and the surrounding deserts, has a preservative influence on dry organic matter, as may be observed in the domestic appliances of wood, cloth, and leather, thousands of years old, that have been found in tombs, and which are to be seen in various museums, notably that of Boulak at Cairo. Hot dry air rapidly absorbs the moisture contained in substances exposed to it, and once dry, the action of oxygen (the principal cause of decomposition) is almost completely arrested. It is for this reason that absorbents, such as dry quicklime, common salt, chloride of calcium, and sulphuric acid are placed in tight glass cases and boxes in which, the air being cut off from the outer air, they become exceedingly dry, and thus the moisture that may be contained in any substance placed in them is first absorbed by the air and then by the absorbent. Very few boxes or even large-stoppered bottles are really air-tight, but the leakage, through imperfect joints, and also the change of the air when they are opened, is easily compensated by the action of the absorbent. If the material to be dried contains much moisture, like tobacco in wet weather, the absorbent may have to be renewed several times before the object is gained. It is preferable to dry cigars slowly, as, if swelled with moisture, the outer covering may burst if dried before the interior is reduced in bulk by evaporation. The same thing will happen to many other substances, such as wood or ivory, if put suddenly in a too dry atmosphere, and if good books are similarly exposed, the exterior of the covers will curl and open at the joints. If bound with leather the leather will pull away from the boards, and nothing but new binding will restore the volume. If the moisture is shut up along with free air in a tight case, active decomposition is likely to be set up if the contents are food or organic matter. Exhaustion of the air, as in the case of preserved meats, will retard decay for a considerable time, but there is a limit, beyond which such goods in a hot climate become unfit for human food.

Numerous cases of fatal poisoning have been known to occur in India from the use of tinned provisions which either had been badly packed or had remained too long unconsumed. Bad packing may be due to imperfect cooking, imperfect exhaustion of the air, the use of cheap tin plates containing lead, or careless soldering, which, although it may be tight when it leaves the factory, gives way during transport or handling. When decomposition begins, the original vacuum in the tins disappears, and the flat surfaces are puffed out, indicating pressure. The contents of the tins are then only fit for manure, but long before this pressure accumulates the contents are unfit for human food. It is the custom in India among respectable dealers to sell off all their doubtful stock at regular intervals, so as to avoid the risk of complaints from clients. This rejected stock is bought up by less scrupulous dealers, many of whom will prick the puffed out tins to release the gas, solder them up again, and then offer them for sale as fresh goods in competition with the merchant from whom they were purchased. The better the reputation of the maker of the rejected goods, the better the chance of sale. If the food is damaged by impure tin plates, the acids in the fruit or the meat combine with the lead mixed with the tin, producing compounds which are highly poisonous, and which act independently of the decomposition of the food or the tightness of the tins. If the inner surface of a newly opened tin is blackened, the contents are open to suspicion. The public have, at present, insufficient protection against the risks of dangerous tinned food, but if a clause were introduced into the Merchandise Marks Act requiring that the year of manufacture should be legibly stamped upon the tin cases (not affixed by ticket), a very wholesome restriction would be laid upon unscrupulous dealers.

Glues and organic cements suffer greatly in hot dry climates as, owing to the shrinkage of the materials on which they are used, the cement gives way unless it is one which is softened by heat instead of moisture. Moisture, as it is found in the air of Bombay, Colombo, or Singapore, is very favorable to the growth of mildew in leather, paper, or in manufactured goods. It quickly tarnishes metals and renders cooked food unfit for consumption after a few hours. No large grain stores have so far been put up in such an atmosphere on account of the risks of heating and deterioration to which the grain would be exposed. In western India the stores of grain are kept on the lee side of the mountains against which the southwest monsoon breaks, and where the air is generally dry and absorbent. Many industries are completely stopped in India during the wet weather mainly on account of the dearth of proper appliances for drying. Others suffer much retardation from this cause. Tile-making is always stopped during the monsoons, and the cigarette industry seems to have failed in Bombay, largely on account of the absence of drying apparatus for absorbing the moisture that had been imparted to the tobacco leaf so as to adapt it to the manipulation of automatic machines. Moist tobacco is rapidly ruined by mildew in a hot moist atmosphere.

Books if bound with ordinary paste are quickly attacked by mildew and by vermin. Beetles will eat off the surface finish from stamped cloth covers. The paste should be mixed with corrosive sublimate or other antiseptic. Books on shelves, unless packed tight, are all hanging by the binding, and a warm damp atmosphere loosens them from the covers if they are large. All large books for use in the tropics should be bound, so that when placed upright on a shelf the

M. COURTOL, THE VIPER-KILLER.

leaves should rest on the shelf—that is to say, the covers should be cut flush with the leaves on the under side. The appearance of such a volume might provoke criticism, but it would never lose its cover in the manner described. Books sewn with wire go speedily to pieces in the tropics. Since wire sewing has been introduced, a very foolish economy has substituted tinned iron wire for tinned copper. The tinning soon disappears from the iron, and the book soon falls to pieces. Damage by vermin is done principally by ants, beetles, and their larvæ; it takes place with great rapidity in the tropics, and cases of pine or other European woods are no protection against them except for very short periods. All the packing cases that come to India are of wood that is not proof against these vermin, and at Indian ports pine wood is cheaper than teak. White woods are, therefore, largely used, especially for temporary structures and fittings. They may be protected by painting with a solution of chloride of zinc or with a solution of mineral spindle oil in kerosine. Bamboos, which in India are nearly always cut at the wrong season, may be preserved by being immersed, when dry, for several hours in a bath of dilute chloride of zinc, made in the proportion of 2½ per cent. This is Sir William Burnett's system of preservation. Corrosive sublimate or perchloride of mercury solution in the proportion of ⅝ of 1 per cent. may also be used. The bath may be made of wood lined with coarse calico and tarred. Bamboos should be cut to finished size before treatment, and, if they are hollow, the joint partitions should be broken with an iron rod so as to let the liquid penetrate to the interior. Woodwork of pine may be painted with these liquids, which should be slightly colored so as to prevent any part from being overlooked. It has been found that white ants and borer beetles will not eat through a poisonous or disagreeably tasting surface.

The Indian climate varies greatly from north to south in temperature, rainfall, and in atmospheric conditions, and the effect of the variable climatic conditions has an important influence, not only on the industries of the country, but upon the merchandise imported and carried through, or stored in it. In the extreme north, the climate is very like that in the mountains of northern Europe; in Kashmir it is that of the best part of northern Italy, while in Allahabad the temperature ranges from 116·5° to 40·8° Fah. In London the mean annual temperature is 49·2°; in Kandy, 72·9°; in Calcutta, 78·4°; and in Bombay, 79·13°. The fluctuation of temperature in England and in India is shown in the following figures:

	Max.	Min.	Range.
London	87·7°	18·4°	69·3°
Lucknow	114·3°	41·0°	73·3°
Allahabad	116·5°	40·8°	75·7°
Bombay	100·2°	53·3°	46·9°

The average dampness of air in London is 82 per cent. of saturation, while in Bombay it is 77 per cent., but whereas in the colder climate a thousand cubic feet of air when saturated at mean temperature contains 0·51 pounds of water vapor, in Bombay it would contain 1·135 pounds. In Nagpore during the hot dry season the air may have a temperature of 122° in the shade, while the moisture may be reduced to 13 per cent., or 0·759 pounds of water out of a possible 5·85 pounds.

The rainfall in India, which all takes place within four to five months, contributes largely in giving to the climate its peculiar character. In

Bombay	it averages	72·25 inches.
Karachi	"	7·34 "
Hyderabad (Sind)	"	8·0 "
Nagpore	"	45·09 "
Allahabad	"	38·51 "

The effect of heavy and continuous rain in the tropics is to produce a dampness in the air quite unknown in Europe, and which is very destructive to many articles of European manufacture. The moisture and heat combined set up all kinds of fungoid growth and decay in goods, which are quite unaffected by the climatic conditions of Europe. Mildew attacks textile goods, leather, books and stationery; arms, cutlery, and metal work require constant supervision to preserve them. European furniture of wood is soon spoilt by swelling and shrinkage, or by borer worms; and liquors, excepting the strongly alcoholic ones, rapidly deteriorate in the heat of India. Perishable goods soldered up in tin-lined cases are not safe, if they have been packed in Europe in wet weather. The heat of the ship's hold in the Red Sea, or that of a closed iron wagon on the Indian Railways, when the iron may acquire a temperature of 160° in the sun, will start mildew in the case by the aid of the moisture within it. Straw and shaving packings hold a good deal of moisture in damp weather, and do much mischief when sent to the tropics. No merchandise, therefore, that is liable to injury from heat or moisture can be long stored in India without serious deterioration.

Although the Merchandise Marks' Act requires the length of each piece of woven fabric imported into India to have its length marked upon it, exactitude is impossible, as, according to the difference of the state of the air, say in Manchester, Bombay, and Nagpore, a roll of piece-goods would have a different length in each of these places. The difference of length in a piece of closely woven unsized calico exposed to the air (in the shade) in February, the driest month of the year in Bombay, amounts to 3 per cent. between one day and another. Between wet and dry weather the alteration of length is much greater. Sized goods alter less in length than unsized, as, while the moist air thickens the fibres of the yarn and thus shortens the fabric, dry air hardens the size and arrests extension. Provision has been made in the Merchandise Marks Act to allow for a reasonable variation of length between the factory in Europe and the port of arrival of the goods in India.

Barrels containing oil are very quickly effected by a hot and dry atmosphere. The moisture from the wood is evaporated more quickly than the oil can replace it, and leakage begins, unless the hoops are set up. Oil, therefore, can only be safely stored in iron tanks. Drug compounds and proprietary medicines are also specially affected in the tropics. Pills lose in time their capacity to dissolve, and gum capsules, by oxidation, become practically waterproof in spite of every possible care having been taken of them.

Musical instruments, composed mostly of wood, suffer more in India from the climate than any other structure of the same materials. Organs, pianos, violins and guitars require frequent repairs on account of the shrinking and swelling of their material during the changes from wet to dry weather. The movement of wood in swelling being across the grain, and not in the length, swelling and shrinking tend to separate the pieces and injure their musical effect. One of the best and most experienced authorities in India, himself a manufacturer of pianos, states that the life of the best soundboard in India is, on an average, eighteen months. At the end of this time it needs rebuilding to restore the original tone. No other material has, up to the present, been found to take the place of wood in the soundboard of musical instruments. Although they are built of the most carefully selected and seasoned wood, they have to be put together in a stove where the heat is as high as the workmen can bear. This shrinks the wood to the greatest degree, and in this state it is firmly fixed to an iron or steel frame. When in a damp atmosphere, it swells irregularly, and this swelling always ends in rupture to a greater or less extent. Rebuilding of the board is then the only remedy.

Steel or iron instruments or weapons meant for use in the tropics should be kept in cases without any linings. Velvet, silk, plush, cloth or leather linings all absorb moisture and cause the instrument to rust. Nothing will keep them so well as linings of baywood or other absorbent timber which has been well painted, while hot, with a melted paraffin wax. No wax need remain on the surface, but if the pores are properly filled, the trouble and loss due to rusting of valuable instruments or weapons may be avoided. During the monsoon rains all wooden cases containing merchandise for transport must be covered with pack sheeting and tarred, unless they are tin-lined. The effect of the climate upon industries in India has been often experienced in the cotton trade. Excessive dry weather, such as is experienced in the interior, produces difficulties in the spinning and weaving of cotton that are quite unknown in England, and excessive moisture during the rains will cause the fiber to adhere to the leather-covered rollers in the spinning frames.

The process of drying merchandise, whether it be

* From The Indian Import and Export Trades Journal, Bombay.

textile goods or other material, demands special arrangements during the rains that may fall for weeks together with very little intermission, and the storage of dried and other goods, such as tobacco or provisions, has still to be provided for. It may not improbably be found in connection with the ice factories that are becoming common in India, and which, by means of a suitable extension, might provide cool storage, as is already done in New York. A sufficient reduction of temperature stops the action of moisture even on the most perishable goods. This may be observed in the case of fish and meat, which, in Bombay, are tainted in a few hours after death. In cold weather in Europe they will keep for several days, and, if well frozen, they may be preserved indefinitely.

Much has already been done for the preservation of perishable goods on a small scale, and the use of absorbents in air-tight cases is a great aid in the preservation of samples used in commerce. Lime, chloride of calcium, salt, dried sawdust, and sulphuric acid have all their uses as absorbents of moisture, and should all be known and understood in a well arranged sample-room.

Glass showcases should have a floor as well as top and sides of glass, for, a wooden floor, being permeable to moisture, will absorb water vapor from the air, and transmit it to the atmosphere of the case. There is thus a flow of moisture through the wood which must either be taken up by absorbents or left to deteriorate the contents of the case. No showcase is absolutely tight unless it be a bottle with the stopper cemented in place. There is, therefore, a circulation of air in and out which is controlled by, and due to the fluctuation of, barometric pressure twice in every twenty-four hours. Every closed vessel breathes twice a day, the inflow carrying with it dust and moisture. The dust settles in the still air of the case, and the moisture is taken up, partly by the absorbent and partly by the articles within. It is this fluctuation of air pressure that gives movement to the aneroid barometer. Camphor has for a long time been used to repel the attacks of vermin upon furs and textile fabrics, but it is now being abandoned in favor of naphthalene and benzine, whose odor is particularly repugnant to insects of all kinds. Kerosene is also much disliked by them, but, being much less volatile, its use is limited. Ants will not crawl up the leg of a table or bed round which a rag dipped in kerosene has been tied, and suspended meat safes may be protected in the same way, with a rag tied round the suspending cord.

Machinery, especially that for textile factories, is imported during the dry season. If it has to be conveyed far from the port of discharge, the makers should be carefully informed regarding the kind of land carriage that will be employed to deliver it. If there is much transport by road, as may easily happen, the quality of the road, the inclines, bridges, and fords should all be carefully examined and reported on, as it might be necessary to restrict the maximum weight of the heaviest article to meet the peculiarities of transport.

THE HELLENIC SOCIETY.

THE annual meeting of the Hellenic Society was recently held in London under the presidency of Sir Richard Jebb, M.P. The report of the council for the session 1899–1900, read by the secretary, Mr. George A. MacMillan, stated that the session had not been specially eventful, but the work of the society in various departments had been steadily carried on. The late Dr. Middleton's "Plans and Drawings of Athenian Buildings" had been published as a supplementary paper, and it is hoped to issue another volume of supplementary papers containing the complete record of the very important excavations carried out by the members of the British School at Athens upon the site of Phylakopi, in the island of Melos. The report also referred to the work of the British school at Athens and the excavations in Crete. The ordinary expenditure for the years was £691, and the ordinary receipts £691.

Mr. Arthur Evans afterward gave an interesting account of his work in Crete, describing in detail a large palace, including the propylæa. Digging down seven meters, he came to traces of neolithic deposits, and it seemed that there was a great superimposition of the works of a much later civilization. In a succession of large magazines great jars resting on pavements were discovered. Underneath were two stone cysts lined with lead at two depths. He was thus led to the conclusion that treasures would be discovered at a still greater depth. There were traces of a great catastrophe at an early age. The whole site, though at the time of the destruction the buildings were plundered, had from that time been left undisturbed. The most interesting part was at the northeast, where frescoes were discovered as fresh as those of Pompeii, from which, however, they were separated by about fourteen centuries.

Here there was what might have been a council chamber or throne-room of, perhaps, unparalleled antiquity. On other walls were frescoes of flowers, water-plants, running water, and fishes. A series of small chambers may have been the harem of the palace, which contained multitudes of figures of ladies among them in costumes which the director of the French school described as almost Parisian. These were quite new in Hellenic art, and seemed to confirm the Homeric statement of the great population of Crete. There was also a part of a Mycenæan shrine, with fresh coloring, like one discovered by Schliemann. Beyond these rooms were the northern propylæa with the remains of a great bull, of which the head and large part of the body were brought out, suggesting the Minotaur. A large deposit of tablets showed the early Mycenæan script. This script seemed to contain about seventy different characters, answering rather, perhaps, to a syllabary than to an alphabet. Other tablets of a different and more developed writing were also found. These were more pictorial and hieroglyphic, and identical with seals which he had previously discovered. Thus there seemed to have been two systems of writing belonging possibly to two different races. Some clay seal impressions, some of them of beautiful Mycenæan gems, were among the most interesting things he found. There were, in a word, evidences of a very high civilization. Other artistic remains disclosed a picturesque style not hitherto associated with that remote period.

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